The Electrical World.

VOL. XXVIII. NEW YORK, SEPTEMBER 12, 1896. No. 11.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. *Cable Address: "Electrical," New York*

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 927 Chestnut Street.

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TELEPHONE CHARGES.

In an article which appears in this issue Mr. West calls attention to a method of automatically registering the number of conversations held by telephone subscribers, upon which is based the charges for service. This method is in harmony with electric light practice, now almost universally conducted on a meter basis. In telephone service the duration of each conversation is not so important, excepting where lines are in great demand. For local calls, therefore, the practice adopted in several of the large cities of America is to charge a fixed rental which permits of an unlimited number of conversations. A second system, employed in the same exchanges, is to charge a fixed rate for a certain maximum number of conversations and additional charges for each conversation above the limit. A record of such conversations is kept by the telephone operator on a ticket system. This method, as Mr. West points out, has the disadvantage that it increases the cost of operating the exchange. The fixed rental in New York City for an unlimited number of conversations is $240 per year. For a maximum of 600 conversations $90 per year is charged and 10 cents for each additional conversation, the rates being graded up to the maximum of $240. For rentals above $90 a rebate is allowed if the number of conversations falls below the maximum stipulated in the contract. Although this method has been found the best in the Bell system, it is not likely to be adopted by other companies where the minimum expense is necessary for successful competition. It is probable, therefore, that automatic self-registering devices will by such be adopted, thereby leading to a practice commendable for its fairness to all subscribers.

MAGNETIC UNITS.

The complete report on magnetic units, presented by Prof. Hospitalier before the Geneva Electrical Congress, will be found in full in other columns of this issue. This splendid résumé, ignominiously received by the Geneva Congress, still more firmly establishes the position taken in 1894 by the American Institute of Electrical Engineers, when names were provisorily given to the C. G. S. magnetic units. It is, however, not upon the particular names chosen that their importance rests, but upon the fundamental reasons for giving names to units, which in their magnitudes, convenience in application and consistency, are such as to make them worthy of acceptance and employment, not merely by teachers and writers, but by all having occasion to deal with magnetic circuits. As stated by Prof. Hospitalier, the practical units should be of the same order of magnitude as the quantities which they measure, a qualification not contained in the system proposed by M. A. Blondel. As to the incomplete and hybrid set of units adopted by the British Association at its last annual meeting, no apparent reason suggests itself for such action other than an attempt to antagonize as effectually as possible the desired aims of the American body. In marked contrast to such feeling is the tribute paid by Prof. Hospitalier to the former in stating that the work inaugurated by it and which resulted in the international adoption of the C. G. S. system of magnitudes and units, "has done more in 15 years for the unification of measurements than the metric system, one of the greatest benefits of the French Revolution." It remains for the British Association, a universally respected body, to reconsider the vote of last year, and to either propose magnetic units having some claim for superiority over those provisorily adopted by the American Institute of Electrical Engineers, or adopt the units

which the latter has proposed. The aim to be strived for is universal agreement, an aim which cannot be attained by the continued existence of the B. A. units.

LI HUNG CHANG AND CHINESE CHARACTER.

The visit of Li Hung Chang to the two leading commercial countries of the world—England and the United States—has given rise to considerable speculation in the minds of the leading business men of both as to the commercial advantages that may possibly be attained as a result of this distinguished Mandarin's tour. In this connection considerable interest naturally centres in the part that electricity will play in the possible future benefits. As far as our knowledge goes we are impressed with the fact that Mongolian and Caucasian minds are quite different and dissimilar in their manifestations of impressions. Li saw a great many wonderful things in both countries, but it was painfully evident that he did not perceive them with a very appreciative eye, and in many cases that which was calculated to entertain him most was the least noticed. But we need not go into details regarding the apparent lack of appreciation of what was done to convince him of the greatness of the leading nations of the earth. Li is unquestionably a shrewd and self-possessed individual, and he may have made mental notes of what he saw, to be referred to at some future time. If he was deeply impressed with anything at all electricity must have played an important part in the formation of such impressions. On Sunday last he was shown the great power generators at Niagara Falls, and he stated that the sight was the most interesting he had seen on his travels. He spoke in glowing terms of American railways, and said, so it is reported, that he would adopt the American practice on the railway now building in China. This alleged reply to an inquiry brings us face to face with the question as to whether he will on his return home advocate the introduction of electricity on a more liberal scale. The telegraph is practically the only electrical institution in China, and it is developed on an extremely limited scale. Its existence, as insignificant as it may seem when compared with our own systems is due to the liberal views held by Li Hung Chang, but how far his progressive ideas will be adopted in the future is an indeterminate question. The business world is looking anxiously for the commercial emancipation of China. Such a momentous event would open an immense market for industrial manufactures, and no doubt electrical enterprise would lead the march of progress in the new field. But are we justified in taking a rosy view of the situation because of Li's visit to the commercial nations? We think not. The time for these things is not yet. The Chinese mind is not yet prepared to receive these new ideas; but there is no doubt that the day is coming when China will be classed among the list of progressive nations, and her demands on the industrial and manufacturing countries will likely give an impetus to trade such as has not been enjoyed for years. At this time there are, however, some potential forces working in opposition to the adoption in China of so-called Western ideas. It is well known that the dowager Empress of China, who is the power behind the throne, and almost the entire official class, are fanatically conservative, and since every enterprise must receive governmental approval very little progress in this direction is to be expected. From what has transpired in Chinese affairs in the recent past, it is not at all probable, from the standpoint of Christian methods, that what Li Hung Chang may report to his sovereign regarding the progress in civilization by other nations will exert any modifying influence on the ultra-conservatism of those high in power. Li was not clothed with plenipotentiary powers when he began his journey around the world, therefore he had no authority to enter into and make bargains involving China's international policy. The primary reason for his departure from China was to attend as the representative of the Chinese Emperor the coronation of the Czar of Russia. It was not to negotiate treaties or invite foreign enterprise to China, as many seem to think. His visit to the other nations was incidental to the real object of his trip, and what trade hopes and expectations have been built up on this casual visit we hardly think are justified under the circumstances.

COMPRESSED-AIR TRACTION.

We have recently had occasion to call attention to the experimental introduction of compressed-air traction in one of the uptown thoroughfares of New York City, and naturally, perhaps, our remarks have not met with the approval of those interested in promoting this method of street-car propulsion. Statements, apparently warranted, but met by refutation and adverse opinions, can lead to no better results than do similar controversies over politics and religion, and for this reason it was our intention to simply wait and allow the compressed air advocates an opportunity to demonstrate their position, but owing to the statements which Mr. Hardie has made in a communication which appears elsewhere in this issue we cannot refrain from referring to some of the conclusions to which French engineers have arrived after having thoroughly tested for some 15 years the possibilities of compressed air for traction purposes. M. B. Abdank, a recognized authority on the past and present conditions of street railway practice in France, states that after various critics have tried every conceivable means of street car propulsion, including ordinary steam methods, superheated steam and compressed air, each with one exception, electricity, has been or will shortly be abandoned. The superheated steam system he considers as dead, although continued in use because of the great cost in effecting a change believed by the managers not to be justified under the existing conditions in the localities where it is now employed. Although the compressed-air system is in larger use, he pronounces the same sentence upon it. No better affirmation of this opinion could be given than that shown by the present status of the several systems now in use in France. Commencing practically but three years ago, there have been constructed in that country 500 miles of trolley roads, while there are at present but 41 miles of compressed air roads, although this system was established in 1881, and a much smaller number of miles of superheated steam roads. Further than this M. Abdank states that there has not been added a single compressed-air line since the trolley demonstrated its superiority. The downfall of compressed-air traction he attributes to the greater cheapness and simplicity of the trolley, the repair cost alone on air motors used in France he states as having been enormous. M. Abdank looks upon the cable system as antiquated and doomed soon to become obsolete. American manufacturers of electric railway apparatus would do well to study the conditions now existing throughout France, and especially in Paris, where the general introduction of both underground and overhead trolley systems are likely to take place before the opening of the International Exposition of 1900. American manufacturers have almost a clear field for the overhead system at least, and one which they will doubtless cultivate with no little vigor.

The Brussels International Exposition.

The Brussels Exposition of 1897, although at first undertaken as a private enterprise, is now a national undertaking and will be made as international as possible. It is evident that international interest is being taken in the exposition from the fact that France and the United States have both made monetary grants, while Germany has appointed a special commission. A commission under Sir Albert K. Rollit will take care of the British interests. American manufacturers who wish to be represented should lose no time in making their intentions known.

On the Seat of Electrodynamic Force in Ironclad Armatures.

BY WM. BAXTER, JR.

In THE ELECTRICAL WORLD of July 4 there appears an article by Messrs. Houston and Kennelly setting forth the results of an experiment made by them to determine whether the electrodynamic force is exerted against the wire conductors or the teeth in ironclad armatures. The conclusion they arrive at is that the force is exerted against the iron, but to the writer the experiment does not appear to prove that such is the case. Under the conditions of the experiment the action would undoubtedly be as stated by them, and a little reflection will show that no other result could be arrived at by a process of reasoning based upon the generally accepted theories of electromagnetic action. The experiment shows that when the armature is at rest the electrodynamic force is exerted against the iron, but it does not show that when the armature is in motion the action would be the same. A correct theoretical investigation would lead to the same result, so far as the static action is concerned, but as soon as the rotation of the armature is taken into consideration the conditions are changed and the theoretical deductions would be contrary to the results of the experiment.

The foregoing statements can be easily presented, as the writer sees them, by reference to the accompanying sketch, in which *AB* represents a portion of an iron bar that forms part of a magnetic circuit. If we drill a hole as at *D* through this bar the space within that hole, according to our notions of magnetism, will be practically free of magnetic force, notwithstanding that it is in the path of a magnetic flux and within the body of a magnetized iron bar. If the above reasoning is correct, a conductor *C* may be placed within this hole and be moved around in any direction without dynamic resistance, and without producing any electrical effects. The iron bar simply acts as a shield to protect the space within the hole from magnetic action.

If we saw the bar *AB* in two along the curved line *FF*, struck from the centre *G*, the conditions will not be changed so far as the hole *D* and the conductor *C* are concerned; and it will make no change in the magnetic circuit except to slightly reduce the flux. If the joint *FF* is separated slightly so as to form an air gap, the conditions will still remain unchanged. If now we saw a slot at *E* from the hole *D* to the air gap *FF*, there will be a small change in the condition of the space within the hole as some of the lines of force that pass across the air gap, from *A* to *B*, opposite *E*, will find their way therein. The density of the flux across the space within the hole *D* will depend upon the width of *E* and the distance from the lower side of the hole to the air gap, the smaller the latter and the wider the former the greater the density within the space. If under these latter conditions the wire is moved to and fro within the hole, an E. M. F. will be set up in it, but as the density of the flux across this space must be even under the most favorable conditions, very low, the action in the conductor must be slight.

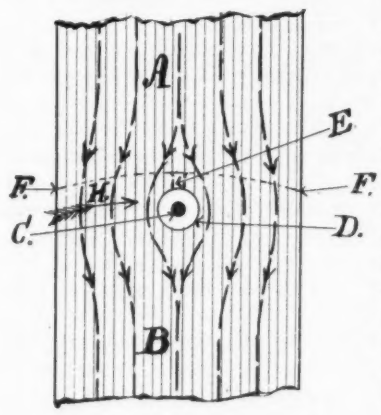


FIG. 1.

If we consider the end *A* of the bar to remain stationary, while the end *B* revolves around its centre, the sketch will represent a pole, and a portion of the periphery of the armature of an electric machine. Considering the action at the instant of starting, the rotation being in the direction indicated by the arrow *H*, we can see that the first effect is to move the lines of force forward, and crowd them together ahead of the hole *D*. This action will set up a stress between the iron *A* of the field and the iron *B* of the armature, because the lines of force will resist elongation and displacement. There will be an effect produced on the conductor *C* owing to the fact that the magnetic conditions within the hole will not be changed. If we now arrest the movement of the armature and move the conductor, we will find that there will be a slight resistance to motion and also that a small E. M. F. will be developed, the magnitude of both actions being proportional to the strength of the field in the hole. If instead of moving the conductor we pass a current through it, it will at once be displaced and with a force proportional to the strength of the current as well as that of the field. These are the actions that must necessarily take place when the movement of either the iron core or the conductor is over a small distance only, but when the distance becomes very great, as would be the case when the armature rotates continuously, the action must be very different.

Assume the position of *A* and *B*, at the time of starting, to be such that the hole is at the extreme left of *A*, then as *B* advances the lines of force will be carried forward and crowded together, and during this time the dynamic stress between the iron pole and the iron core will be about the only resistance opposed to the rotation of *B*. But, eventually, the displacement of the lines of force will reach a point beyond which it cannot be carried. When that point is reached the lines will cut across the hole *D* and the conductor *C* and an E. M. F. will be developed in the latter. At this instant the stress between the pole and the iron core will cease, and will be set up between the pole and the conductor, from the very fact that a conductor cannot be moved across a magnetic field without resistance any more than a stone can be lifted without resistance. An electric current in a conductor may be regarded as a screw moved longitudinally by the rotation around it of a nut having no lateral motion, this nut being the magnetic field of the current. Presenting this picture to the mind we can see that when the conductor is cutting across a magnetic field the lines on one side will run with the lines of its own field or the nut, and on the other side they will run against them. This latter interference will cause a dynamic stress between the wire moving with the armature and the stationary pole, and will also tend to resist the electric propagation through the wire and develop an E. M. F. opposed to that of the current.

All the lines of force whose action is impressed upon the conductor cannot, while that action is going on, also act against the iron core, for if they could we would have a way in which a force could be made to act in two places at the same time, and therefore the energy developed as the result of the motion produced would be double what it should be. Considering the action as above outlined it must be evident that in the rotation of an armature of the grooved or ironclad type, the dynamic force is exerted against the core for a short interval of time, during which the lines of force are being displaced by the forward movement of the air space in the groove behind them, and that when this displacement becomes sufficient, they cut across the conductor, and in so doing act against it, so that the dynamic force exerted between the field and the armature is alternately impressed upon the core and the conductors.

In the experiment of Messrs. Houston and Kennelly the force was shown to act almost wholly upon the iron simply because the rotation of the armature was only enough to cause a displacement of the field and not an actual cutting of the lines across the conductors.

Magnetic Units.

The following is a report on magnetic units made by Prof. Hospitalier to the International Congress of Electricians, held in Geneva, Aug. 4-8. After some discussion the report was laid on the table, thus leaving the question to which it referred for a future congress, which will probably be that of 1900, to be held in connection with the Paris Exposition of that year.

"The usefulness of an international nomenclature of magnitudes and physical units needs no demonstration at this time. The work commenced by the British Association in 1864 has been fruitful of results, and all international congresses which have succeeded it since 1881 have sanctioned and contributed to the completion of the C. G. S. system, the international adoption of which system has done more in 15 years for the unification of measurements than the metric system, one of the greatest benefits of the French Revolution. The nomenclature of electrical units is to-day fixed, and for some years past attention has been directed toward the magnetic units, with a view to completing a work which has, even in its unfinished state, so largely contributed to the progress of the electrical industries.

"Time was lacking during the Congress held in Chicago in 1893 to establish a rational and coherent nomenclature for magnetic quantities and units, but the gap thus left has made itself rapidly felt, and in 1894 the American Institute of Electrical Engineers proposed to fill it by applying the names of illustrious electricians to the principal C. G. S. magnetic units—M. M. F., reluctance, magnetic flux and magnetic density or field intensity.

"Since that time other propositions have come from various sources, and as these propositions are contradictory, an international

understanding becomes necessary. The present congress offers us this occasion, with the hope of success.

"A certain number of electricians, among whom are the most illustrious, have considered it useless to create special names in order to designate the magnetic units. According to them, it is sufficient to adopt the C. G. S. units, and merely add to the numbers which express their magnitudes the words 'C. G. S. units,' or even to employ no special designation, after agreeing once for all that none but these units are to be employed.

"However academic this solution may be, it is not satisfactory to practical men. It is necessary for them to have concrete notions, precise terms, tangible words, to differentiate the magnitudes by means of the names which serve to measure them. The learned could continue to use the C. G. S. units and leave to the practitioners the special terms. We would not have to wait long before the learned would adopt the new, more common, more rapid, and more precise terminology. If an example is wanted, we find it in the word 'voltage,' which was created in electrical stations in order to replace the fastidious expression, 'difference of potential;' even the *Comptes Rendus* of the Academy of Sciences to-day accepts voltage. If care is not taken, 'amperage,' 'wattage' and 'ohmage' will creep in and implant themselves, as has the word voltage, despite the irrational formation. In order to avoid this condition, it is useful, and at the same time urgent, to fix for all time magnetic nomenclature, by stepping from the elevated domain of science to the more earthly level of current practice. The necessity of special names once admitted, it remains to determine upon the choice of these names and the magnitude of the units to which these names should be applied.

"The American Institute of Electrical Engineers proposes to apply one set of names to the C. G. S. units. Prof. Lodge, on the one hand, and M. André Blondel on the other, wish to give these names to practical units conveniently chosen from among the multiples of the C. G. S. units, the principal aim being to avoid the use of the factor 10^{-8} in formulas which unite E. M. F. with magnetic induction in the calculation of dynamos, transformers, etc. We have thus found ourselves confronted by two systems, of which the following table is a résumé:

Table of Principal Magnetic Units.

Magnetic Quantities.	Symbol.	Name of C. G. S. Unit Proposed by A.I.E.E.	Proposed by M. A. Blondel.	
			Ratio of Practical Unit to C. G. S. Unit.	Name of Practical Unit.
Field intensity.....	$\mathfrak{H}$	Gauss.	10^{-1}	Hertz (or Gauss) per cm.
Flux density.....	$\mathfrak{B}$	Gauss.	10^{-8}	Maxwell (or Weber) per cm.
Magnetic flux.....	Φ	Weber.	10^{-8}	Maxwell (or Weber).
Reluctance.....	$\mathfrak{R}$	Oersted.	10^{-9}	Arago (or Oersted) or Maxwell per Hertz.
Magneto-motive force.	$\mathfrak{F}$	Gilbert.	10^{-1}	Hertz or Gauss.

"We believe after looking at this table that no hesitation should exist, and that preference should be accorded to the system proposed by the American Institute of Electrical Engineers in 1894, for the following reasons:

"The practical units ought to be of the same order of magnitude as the quantities which they measure. The system proposed by M. Blondel leads to the use of units much too small for the needs of practice, even though adopting the multiple 10^6 (mega) of these units, while the C. G. S. units are of convenient magnitude.

"The use of two distinct units for magnetic induction and field intensity is not desirable, for it introduces incessant errors in the calculation of magnetic flux in apparatus such as dynamos, which are composed of iron separated by air spaces.

"Furthermore, the composite names proposed by M. Blondel are much too complicated to pass into practice: each unit ought to have a simple name, easy to remember and sufficiently short, so that the practitioner will not be tempted to abbreviate it. But the greatest objection of all is the inconvenience of a practical system based upon multiples of the C. G. S. units. The following views on this subject are from a report by M. H. Pellat, chairman of the committee named in 1893 by the Société Internationale des Electriciens for the purpose of examining the propositions made by the American Institute of Electrical Engineers, concerning a system of practical magnetic units founded on multiples of the C. G. S. system:

"The proposed practical unit of M. M. F. under the name of gilbert, equivalent to 10^{-1} C. G. S. units, is much too small. On the other hand, the practical units of field intensity and of magnetic flux proposed under the names of gauss and weber, and which are equivalent to 10^8 C. G. S. units, are much too large. The use of the gilbert will present, it is true, the advantage of giving in that unit the result of calculation of M. M. F. by the formula $4\pi nI$, when the intensity of the current, I, is expressed in amperes.

"The use of the gauss will present, also, the advantage that in expressing with this unit the intensity of the magnetic field, $\mathfrak{H}$, the E. M. F. of induction, E, developed at the terminals of a conductor, l centimetres long, placed perpendicular to the lines of force and normally cutting them at a velocity, v (cen. sec.), will be expressed in volts by the formula $E = \mathfrak{H} l v$. But the simultaneous use of the gilbert and of the gauss would lead in calculations to errors through forgetting the factor 10^9, in calculations of the magnetic intensity by dividing the M. M. F. by the length of a tube of induction. By expressing in gilberts the M. M. F. and in centimetres the length, the intensity of the magnetic field will be given in terms of a unit having a value of 10^{-1} C. G. S. unit and not 10^{-8}. It would then be necessary in addition to divide the result by 10^9 in order to have the intensity expressed in gausses. It appears then wiser not to introduce these new units, which are inconvenient in their magnitude and dangerous for exact calculation.

"After the Chicago Congress, the American Institute of Electrical Engineers, recognizing the weight of these objections, modified its proposals, and, while preserving the same names, applied them to the C. G. S. units themselves, and created the provisional system for which we have to-day come to request your sanction by a favorable vote.

"The only objections which can be raised to this system are, on the one hand, the alleged uselessness of these names, and to this we believe we have made sufficient answer; and, on the other hand, the use of a common unit for the measurement of the magnetic field and magnetic induction. As to the latter, in the electromagnetic system, these two physical quantities have for their relation $\mathfrak{B} = \mu \mathfrak{H}$, with the fundamental hypothesis that μ is an abstract number, a simple numerical ratio. Inasmuch as one does not have to determine the absolute dimensions of the magnetic permeability as a function of M, L and T, it will be logical and rational to measure $\mathfrak{H}$ and $\mathfrak{B}$ by a unit which serves for both, in the same manner that we use the same unit, the centimetre, for measuring length, breadth, height, thickness, the coefficients of induction in the electromagnetic system and capacities in the electrostatic system. In all the works of Lord Kelvin—an undisputed authority in England, as in the whole world—are not resistances expressed in centimetre-seconds? Does not Dr. Hopkinson express torque in joules in his papers on tramways? Lord Kelvin well knows, however, that a resistance is not a velocity, and Dr. Hopkinson is aware that a couple is not work. They use, however, the same units, and with reason, because they result from the hypotheses made for the establishment of a coherent system as simple as possible, and which consequence naturally follows from these hypotheses. The day when the more advanced state of science will permit of suppressing these hypotheses and of establishing the absolute dimensions of physical quantities, and on that day only, will it be necessary to commence over again and create new names in large number, since it would be then no longer correct to measure with the same unit two quantities not having the same dimensions; but in the present condition of science and with the fundamental hypothesis which serves as the basis of the electromagnetic system—an hypothesis which makes of magnetic permeability a simple numerical ratio—it is coherent, logical and rational to measure $\mathfrak{B}$ and $\mathfrak{H}$ with a single and the same unit. These few considerations seem to justify the following resolutions, which will serve as a conclusion to this paper.

"The International Congress of Electricians, convened in Geneva, resolves as follows:

"*a*. That the C.G.S. magnetic units be adopted as practical units.

"*b*. That in order to facilitate teaching and the diffusion of these units, names should be given to the principal magnetic units conformably to the propositions made in 1894 by the American Institute of Electrical Engineers."

Zinc Plating.

According to Minet, a small quantity of sulphide of zinc added to the usual solution of sulphate of zinc, for zinc plating, will give a much more compact deposit.

Electrical Equipment of the New England Building in Cleveland.

CLEVELAND is a city having but few large metropolitan buildings, but of these the New England Building, 15 stories high, is one of the most prominent. It was built by Norcross Bros., of Worcester, and, of course, in order to be thoroughly up to date, it must have a complete electric plant, which feature has not been neglected. There are two basements to the building, the electric plant with boilers and other necessary accessories being located in the lower.

There are four multi-tubular boilers 18 feet long, 60 inches in diameter and carrying 48 flues. They burn about 10 tons of coal a day, carrying a six-inch spread fire. It must be remembered in estimating the output of the plant that a large quantity of steam is supplied to outside concerns from these boilers. The boilers are provided with full fire-fronts and have the Hawley down-draft system. This system, it will be remembered, consists of forming the grate bars of tubes through which water is circulated and drawing away the products of combustion by a powerful draft from beneath the grate, thus forcing the smoke down through the fire and causing its complete combustion. An ordinary grate would be rapidly destroyed by the intense heat, but by circulating water within the bars this trouble is avoided and the circulating water can then be used to feed the boilers. Moreover, a simple spread firing has the effect of coking the coal as it descends toward the base of the fire.

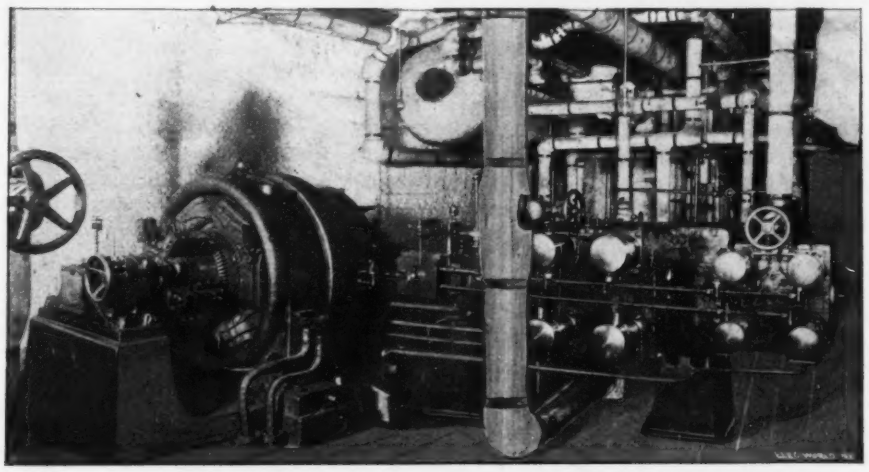
The grate surface is 6 x 6 feet, and is 24 inches below the boiler shell. The draft is maintained by a stack 80 feet high. Lake water is used, being supplied by three feed pumps through a single-feed pipe system. A single system of magnesia-covered steam piping delivers the steam to each engine, first passing through a Stratton separator.

There are three engines, each exactly alike and of the compound tandem type. They are known as the Atlas cycloidal engines, and while the valve gear is detaching, yet the crank motion is positive, and the engine attains the remarkable speed of 275 revolutions per minute, and at the same time has genuine Corliss economy. From the illustration, it will be seen to have a most substantial and solid appearance. It is known as the heavy-duty engine, and apparently does not belie its name. There are two eccentrics, one of which drives the cut-off valves and the other the release valves. Sight-feed oil-cups are provided, and the engine is equipped with suitable drips and drains, and exhausts into an Excelsior feed-water heater A heavy fly-wheel of approximately the same diameter as the field magnets is fixed to the common shaft and located between the engine and generator.

BOILER ROOM.

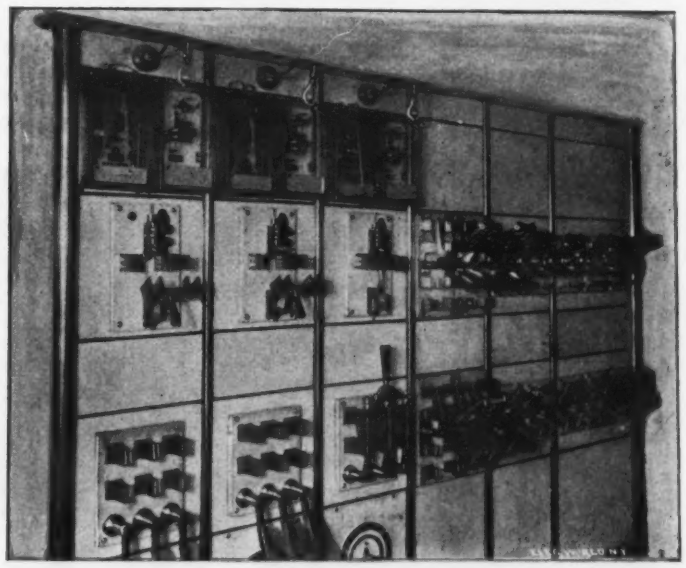
The 60-kw generator is of the six-pole type, and has brushe- driven by the bevel gear and worm-wheel attachment common on Westinghouse machines. The coils are formed on the spiral end connector system, and the armature is of course of the toothed type. The pole-pieces are wound with two coils, series and shunt, each independent of the other. The generator has an outboard bearing and the whole set is particularly solid and substantial in appearance. Its two consorts are of the same size, and the total output of the station is therefore about 3000 lights. The machines run in multiple and are provided with equalizers connected in by three-pole switches, the two outside blades of the switches taking the machine terminals. Each machine has a circuit-breaker, an ammeter and a voltmeter. The use of circuit-breakers is becoming quite common on lighting generators.

The switchboard is of white marble with brass trimmings and is essentially Westinghouse in its appearance. There are in all 14 circuits. Each machine has its own panel, which is devoted to its switches and instruments. The instruments are all of the Westinghouse make and work on the solenoidal gravity principle. The switches for the sub-circuits are double-throw and any and all of the circuits can be switched from the generator onto the local lighting system. By this means the load can be economically carried, even though the three engines are of the same size, so that there is no reason for running any of them at other than full load.



ONE OF THE GENERATING UNITS.

The building is wired on the cabinet system, there being cabinets fitted with locks placed at suitable locations all over the building, built into the walls and finished in accordance with the neighboring woodwork. In the New England Building there are about 2500 lights, but 59 arc lamps in a neighboring building are supplied from the New England Building circuits. The wire is run in iron-armored conduits and circular loom tubing, and also upon heavy insulators in the basement. The plant is said to be giving excellent satisfaction.



SWITCHBOARD.

Central-Station Working—XIX.

A Vermont Two-Phase Plant.

BY A. E. WALDEN.

Of the municipal electric lighting plants installed in the small town in the State of Vermont, the town of Hyde Park has taken a stand somewhat in the lead by supplying light, power and heat.

Two-phase apparatus manufactured by the Westinghouse Electric & Manufacturing Company, consisting at present of one 45-kw generator, has been installed. There are several advantages in two-phase generators of this type, such as the short time and small amount of labor required to replace a damaged or defective coil in the armature. Also the method of winding is such that a difference of but seven-tenths of the maximum potential exists between collector rings, taken as they come, while in plants where both single-phase and two-phase generators are used, the day load, consisting mostly of motors, may be carried by the two-phase generators. This type of two-phase generator may also be operated as a single-phase but the output will be decreased.

The system of wiring has been so installed that advantage may be taken of the difference of potential between collector rings as they come. Twenty-two hundred volts is the line potential at full load, making it necessary to use 40 lamps in series for the street lighting service. As 80 street lights are required, two sets of 40 in series are connected into parallel to a common return wire which allows of control of light at the station. In case of accident such that the full working potential of 2200 could not be used, the street lights can be connected with 20 in series operating at a potential of 1000 volts. These changes can be made in one half hour.

At present there are 1000 52-volt 16-cp lamps connected to 17 transformers at times overloaded 100 per cent. and ranging in size from 500 watts to 6250 watts. There are also three motors of 2, 3, and 20-horse-power each, requiring respectively two transformers of 10,000 watts, two of 1500 watts, and two of 1000 watts.

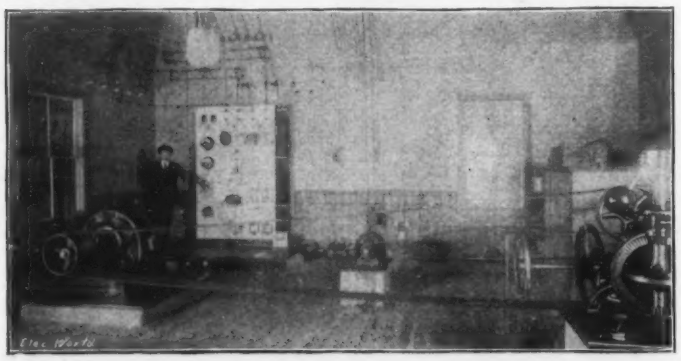
For lighting purposes the following list gives the sizes and number of them in use: One 6250-watt transformer, one 1000-watt, six of 1500 watts each, five of 2000 watts each and four of 500 watts each.

There is at present one office heated electrically and the plant is heated in the same manner by heaters manufactured by the Consolidated Car Heating Company.

The line is three miles in length, consisting of four No. 6 B. & S. copper conductors, also two telephone wires, which are crossed every quarter of a mile. The Phœnix long-distance telephones are used and no trouble has been experienced due to induction.

The loss in the line amounts to 120 volts due to ohmic resistance, and about 35 volts inductive drop, not including four choke-coils of 12 turns each one half mile from the plant, and to which the line lightning arresters are connected, the point in view being to avoid the cost of a large number of arresters and to force the discharge at this point if possible.

The line conductors entering the station run directly to the arresters. Connection is then made to the board with coils of 15 turns and 3 inches in diameter interposed. There are no right angles in the ground wire running to the ground plate, which is of

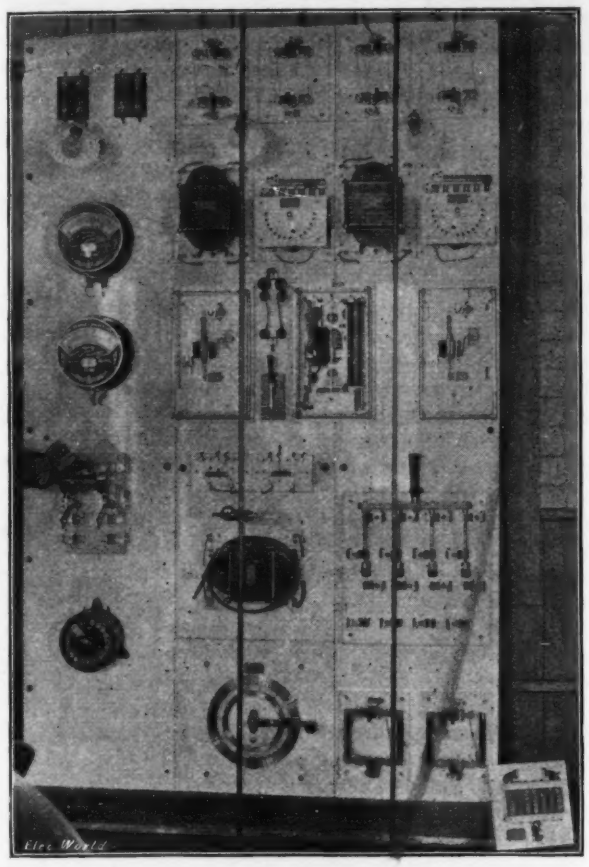


Dynamo Room.

copper, 2 x 4 feet and covered by four feet of water. The line arresters are connected to plates of the same size as the above, buried six feet in marshy ground with a two-foot layer of coke.

The lightning arresters are all of the Wurts non-arcing metal type and thus far in no case has a discharge passed the 15 turn coils at the station. The line arresters have stood repeated discharges without material damage.

While it may not be considered good engineering to overload transformers 100 per cent. for very long periods, it is good engineering to use as large transformers and as few as possible operating at full load or as near it as is practical. Any standard make of transformer will stand an overload of 25 per cent. without material damage. In the lighting of residences there will not be more than one half the lamps burning at any one time, though two thirds or three quarters are generally taken, but in small towns there will not be many over one quarter burning, with the exception of offices and



Switchboard.

stores. In this particular case the converters are operating between three fourths and full load from 4 to 9 p. m. in the Fall and Winter

The Shallenberger ampere-hour meters are used, the rate being one third of a cent per ampere-hour, with a minimum of $14.00 and 10 per cent. meter rent. The rate charged for power purposes is 9.5 mills per kw-hour.

The Supply of Rubber.

Manufacturers and dealers in India rubber goods are turning their attention to Southern Florida as a possible source of supply of the gum, the increase in the consumption of which grows at a much quicker rate than the production. At the present time the electrical industries alone demand a greater supply than was used in the world's entire rubber industry a generation ago, when 10,000,000 pounds was considered sufficient to meet the demands for two or three years. The necessity for new sources of supply is well understood in the trade, though no immediate anxiety is felt. Doubtless there is enough caoutchouc in the world to meet all the demands of the present generation. Possibly there is more than this and the next will use up. But the demand is increasing at a rate that is not realized except by the dealers and manufacturers.

The annual consumption of the crude gum is now between 60,000,000 and 70,000,000 pounds, and about two thirds of this is now supplied by Brazil. The other third comes from various parts of the tropical and subtropical world, and from time to time new fields are opened, as the older ones are worked out. It is well known that the trees are sacrificed in the gathering of the gum, as the savages, who alone are employed to gather it, make no effort to save any tree after tapping, but on the contrary, suffer it to bleed to death, thereby destroying enormous forests.

If, therefore, a considerable supply can be found in Florida, and if discretion and intelligence can be made to take the place of the barbarous methods of the savages, the discovery is likely to be of the utmost importance.

An Arrangement for Counting the Conversations of Telephone Subscribers.*

BY JUL. H. WEST.

The system for fixing telephone rates introduced almost exclusively up to date has been to charge an annual rental. This system fixes a price regardless of the use of the telephone by the single subscriber and consequently does not consider how much work and expense his calls involve. The general opinion of this system is that it is an unjust one because it burdens financially the subscribers who use the telephone little and favors those who use it a great deal and in this way, to a certain extent, checks the general introduction of the telephone. Very seldom an opinion to the contrary is expressed. This subject, however, has been treated so exhaustively that I will omit to enter into discussion here. It may be sufficient to state that a suitable system for counting conversations has not yet been provided, although this is a necessary condition for fixing telephone rates on the basis of the number of conversations. The counters thus far constructed are either too complicated or too expensive or they fulfill insufficiently the requirements of which perhaps the most essential one is to distinguish between a mere unsuccessful call-up and an actual conversation. Further they all make the service more difficult and make both service and equipment more expensive by requiring more working places and more attendants. The Swiss systems, in which the attendant puts down the successful calls as a basis for fixing the charge, is for the above reasons not recommendable. All suggested counting-systems have consequently—if at all applicable in practice,—the disadvantage that they increase both the first cost of the exchange and the expense of running the same, every increase in cost worthy of mention, however, decreasing the value of the telephone.

The equipment which I have lately described,[1] makes it in the simplest manner possible to automatically count the actual conversations, so that the service is not made more difficult in any way. The extra expense is but three to four marks per subscriber, the cost for the (automatic) counting device which is operated by a simple electromagnet.

If an electromagnet is put into the circuit L_3 in Fig. 1, in the place where this letter is, then it will operate each time one of the sockets in the subscribers' board is plugged, as is plainly seen from

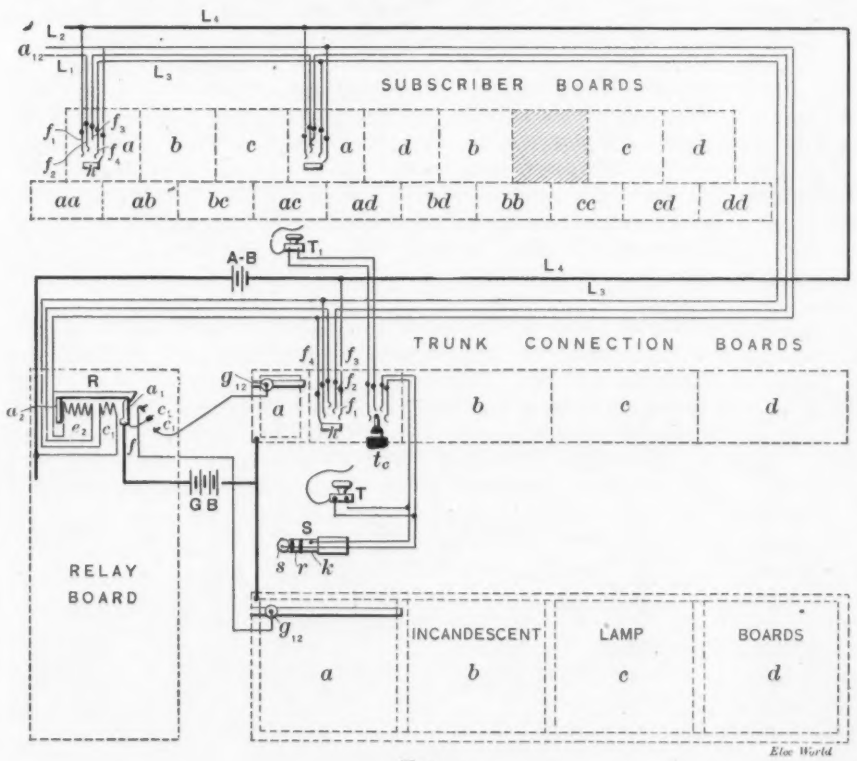


FIG. 1.

the diagram. It will, however, not work when one of the sockets in the call board is plugged. If this electromagnet sets into motion a counting device, then this device will count the actual conversations only, but not the unsuccessful calls.

With this arrangement the conversation will certainly be counted for the calling and for the called-up subscriber, and consequently the price for one conversation will be divided between the two. This may be looked upon as an advantage, because one of the most frequently cited arguments of the opponents of the counting system is that most of the subscribers will use the telephone less when they are conscious of the fact that they have to pay for each desired connection. Such a limitation in the use would easily give an unfavorable financial result. Although I do not believe that much apprehension need be entertained in relation to this, it is certainly desirable to fix the lowest possible rate for each single connection.

According to previous calculations it may be accepted that an annual subscription price of 30 to 40 marks ($7.50 to $10) plus a fixed rate of 4 pfennigs (one cent) per conversation, would amply pay all costs. As, however, according to the system suggested all conversations are counted twice, the total cost for a subscriber would be the annual tax plus only 2 pfennigs (one half cent) for each conversation. This rate is so low that certainly nobody who uses a telephone would restrict himself in its use.

It would further be possible to make the arrangement so that the desired successful calls are counted only for the subscriber who calls up. Then all that would be necessary is a small electromagnet which had to be put in the wire between circuit L_3 and spring f_4 of the socket h of the call-board. It has to be connected with the first-mentioned electromagnet so that the armature of this electromagnet can only act when the armature of the first-mentioned one is attracted. This is only the case with the calling subscriber when the connection is made, and while in his socket in the call-board the plug of the operator is still inserted. Therefore the counting cannot take place for the called-up subscriber while his socket is plugged.

Even if the higher first cost and the more complicated equipment of this arrangement as compared with the first-described one is not considered, I still believe that the counting of the conversations for both subscribers is more advantageous in view of the above stated reasons.

* From advance sheets of *Electrotechische Zeitchrift* forwarded by the author.

[1] THE ELECTRICAL WORLD, Aug. 22, 1896.

Some of the Difficulties Involved in the Introduction of Telegraphy in China.

While his Excellency Li Hung Chang was in London a visit was paid to the works of the Telegraph Construction & Maintenance Company, Greenwich, on the joint invitation of this company and of the Eastern Extension and Great Northern Telegraph Companies. Notwithstanding the elaborate preparations made in his honor and the privileges extended him for inspecting the process of manufacture of submarine cables, we are informed through our English contemporaries that Earl Li was most impressed with the tents erected which served the purpose of luncheon and retiring rooms. In his reply, through his interpreter, Lo Feng Luh, to the remarks of the toastmaster, the Marquis of Tweeddale, Earl Li stated that "we live in a world of evolution, in which the two principles, the struggle for existence and the survival of the fittest, will always hold good. Telegraphs and railways are the fittest means of communication, and these companies which entertain us, I daresay, are the fittest manufacturers and controllers of one of the fittest means of communication. They are the pioneers who work in the new field of their enterprise in the East, and who serve as the best instructors of the Chinese as to how to build telegraph lines. I have always advocated the amalgamation and combination of European skill with the unlimited natural resources of China; and the prosperity of the Chinese telegraph administration shows the effect of this combination. I hope that the other companies will follow the example of the two cable companies who are the pioneers in the East, and who have effected a combination of European scientific knowledge with the Chinese natural resources, not only for the benefit of England and China, but for the benefit of human kind in this world." Commodore Suenson, managing director of the Great Northern Telegraph Company, in his remarks on submarine telegraphy, observed: "It is not only a sense of duty, but also the sentiments of my heart that prompts me to speak on behalf of the Great Northern Telegraph Company, of Copenhagen, with which I am so closely connected, and to which belongs the honor of having established the first submarine cable in Chinese waters, and the first overhead land lines on Chinese soil. In fact, it is now more than 26 years since I went out

to China to arrange for the establishment of our first cables; and to speak the truth, the object of my visit was not greeted with enthusiasm either by the Chinese, who did not yet realize the idea of telegraphy, or by the European residents, who only too well realized the immediate effect of the innovation. I here specially refer to the great commercial firms and houses, who were quite aware that the extension of the telegraph lines to China would deal a severe blow to their supremacy by putting an end to great speculations and by enabling the small merchants to keep in touch with the movements of the markets all over the world. However, once laid down, the cables were freely used by the Europeans and only *too* freely by the Chinese, although not exactly in the way we should have preferred. In fact, large pieces of them were picked up by the Chinamen, and the copper and steel wires were turned into nails for tea-boxes; this really was "to add insult to injury." By-and-by, however, the intelligent Chinese merchants convinced themselves that telegraphy was neither humbug nor deviltry, and that the cables could be used in a more respectful and profitable way. The object of my company was, however, not only to lay cables, but also to build land lines, which might spread the benefit of telegraphy to the 400,000,000 of people living within the limits of the Celestial Empire. But here we had to deal with the less intelligent and more superstitious populations of the interior. For 10 years we struggled hard, and lost no opportunity to further our object. In 1874 and 1875 we thought we had succeeded, having obtained permission from the authorities at Fohkien to build a land line between Foochow and Amoy. The country was surveyed and the building commenced by our engineers; but when 30 miles of the line had been erected, it was torn down by the population, under the pretext that it interfered with the graves and was offensive to the famous 'Fungshui,' that it attracted the evil spirits, and what not. After a whole year's repeated vain attempts we were obliged to give it up, succeeding, however, in saving out of the wreck a short telegraph line between Foochow and Pagoda Anchorage, as well as a telegraph school for the instruction of Chinese pupils. These and many other efforts in different parts of China, however, paved the way, and had above all the effect of drawing the attention of his Excellency, the present Ambassador Li, to the subject. From the year 1880 I may truly say that his Excellency became the Providence of telegraphy in China, as he has been China's Providence in many other respects. He gave a contract for establishing a land line between Shanghai and Tientsin and a telegraph school for young Chinamen at the latter place. This was a considerable work. The line had a length of 900 miles, and entailed the erection of not less than 21,000 telegraph poles, besides the crossing of several rivers by cable. Nevertheless the whole line was built in about five months, and I am glad to say to the entire satisfaction of his Excellency. I need not add that all the superstitious fears about its interfering with anybody or anything vanished as soon as it became known that the work was performed under the protection of China's most eminent and all-powerful statesman. From this moment the development of telegraphy in China may be illustrated by saying that the telegraph poles in China's fertile soil vied in growth with the bamboos. In a very few years a network of telegraph lines was spread over the Middle Kingdom, forced its way even through the Chinese wall, and now extends to the remotest frontiers of the immense empire. I am proud to say that most of these lines have been surveyed by and built under the superintendence of Danish engineers, and I feel sure that my British colleagues and friends, who, with their great predecessors in submarine telegraphy have covered England with more unfading glory than any other nation, will not grudge the small country which was the fatherland of Oersted the honor of having introduced telegraphy in the far East. Allow me to add one more fact. Although China since 1884 has been engaged in two wars with foreign powers, neither the Chinese Government nor the French in 1884 and 1885, nor the Japanese in 1894 and 1895 have interfered with the telegraph cables landed on Chinese territory or with the service performed by them. They have been allowed to pursue their neutral, useful and peaceful work to the benefit of all parties concerned, although in the last war they directly connected the two belligerent powers. This is a proof of regard for neutral property, of respect for international telegraphy, and of recognition of the immense services rendered by it, which ought to be noted, and to serve not only as an example worthy of imitation, but also as an argument in favor of the submarine companies' repeated demands for the neutrality and the inviolability of neutral cables in time of war."

A Non-Synchronous Two-Phase Alternate-Current Motor.*

BY ERNEST WILSON.

The principal object of these experiments was to investigate the currents in the armature conductors and their effects upon the magnetic field of the motor, although other matters are dealt with. The form of motor experimented upon is shown in Fig. 1, the stationary part which receives the two-phase currents having four poles projecting radially inwards upon the armature. This stationary part is built up of 24 B. W. G. soft iron plates of the shape shown, a sufficient number being taken to make up a length of 6 inches. This part is not of the type now met with in these motors, and therefore the results do not pretend to represent recent practice. Each radial projection limb is wound with 102 turns of 2 mm copper wire. The two-phase currents are supplied by two Siemens W 12 alternators, the armatures having a phase difference of a quarter period. The connections between alternators and stationary part of motor are shown in Fig. 2. There are two distinct circuits

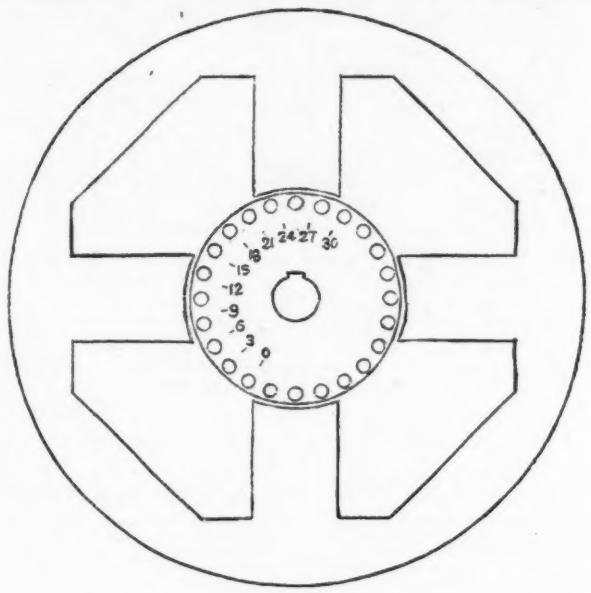


Fig. 1.

on the motor, which are numbered 1 and 2 respectively. In Fig. 2, r_3 r_4 are non-inductive resistances in each circuit, which serve for the determination of current, the potential difference between the ends of either resistance being determined at any moment by means of a revolving contact-maker, *C*, fixed to the shaft of the alternators, and a quadrant electrometer, *Q*. The potential difference between the extremities of each circuit was reduced by means of considerable non-inductive resistances r_1 r_2, and measured at any epoch on the quadrant electrometer.

The armature is built up of sheet-iron stampings 5 inches in diameter and ½ mm thick, a sufficient number being taken to make up a length of 6 inches. The conductors are insulated, and threaded through a series of 24 holes $\frac{5}{16}$ inches diameter, punched out of the discs at equal intervals, $\frac{1}{16}$ inch from the edge. As in the case of the stationary part, the plates are not specially insulated from one another. The copper conductors are solid, with the exception

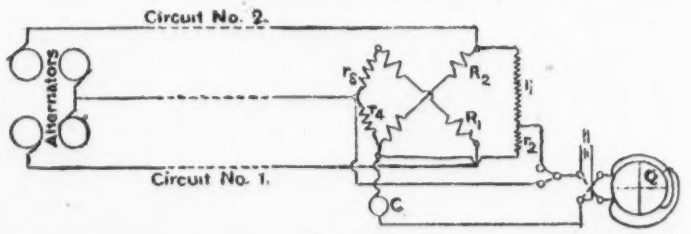


Fig. 2.

of four, which are copper tubes; these being at opposite ends of two diameters, at right angles to one another. The 24 conductors are soldered into solid copper rings at each end of the armature.

An exploring coil of 94 complete convolutions is threaded through two of these tubes at opposite ends of a diameter, the ends of the coil being soldered to insulated rings on the shaft, contact being made with the rings by means of brushes insulated on a wooden

* From advance proof-sheets of the London *Electrician*.

support. On an extension of the motor shaft, remote from the pulley, is fixed a small contact-maker, which makes contact once in each revolution. The position at which contact is made can be determined on a divided circle, and the contact-maker placed in any part of any circuit.

Let E_1, E_2 be the potential difference in volts at the extremities of the circuits Nos. 1 and 2 respectively at any epoch. Let R_1, R_2 be the resistances in ohms of those circuits, and x_1, x_2 the current in amperes at corresponding epochs. Let m_1, m_2 be the total turns on the two circuits, and I_1, I_2 the total induction. Then—

$$E_1 = R_1 x_1 + m_1 \frac{d I_1}{d t}, \qquad E_2 = R_2 x_2 + m_2 \frac{d I_2}{d t},$$

in each case. The curves in Fig. 3 give the amperes x_1 x_2 and volts $\frac{d I_1}{d t}$, $\frac{d I_2}{d t}$ when the motor is running light, and when loaded by means of a rope brake on the 5-inch pulley.

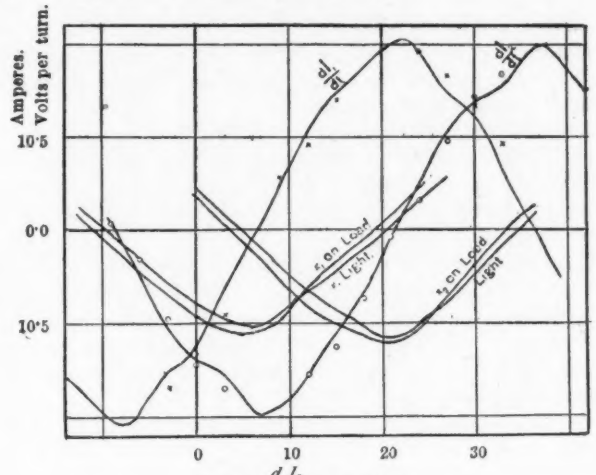


FIG. 3. $\frac{d I_1}{d t}$ on Load X

$\frac{d I_2}{d t}$ on Load O.

In Fig. 3, f_1, the frequency of alternator, is 33.5 and 35.5, and f_2, the frequency of the motor, is 33.3 and 34, motor running light and loaded respectively, as measured on a Harding counter. It is interesting to examine the agreement between the theoretical characteristic curve of this motor and what we have observed. Circuit No. 1, in series with a non-inductive resistance, was excited from a set of 56 storage cells with a current of 7.6 amperes. Exploring coils were wound on the cores of each circuit, and a coil threaded through the punched holes in armature so as to embrace an angle of 90 degrees. This coil could then be placed opposite any of the four poles, and the kick on a ballistic galvanometer in its circuit noted when reversal of current in No. 1 circuit took place. Kicks were also observed when the ballistic galvanometer was placed in circuit with each of the exploring coils on the magnet limbs.

The results show that the ratio of induction in limb to induction in armature is 1.25 for No. 1 circuit. The effect of the cores of the No. 2 circuit cannot be strictly neglected, owing in great measure to inaccuracy in the length of the respective air spaces. Kicks were observed on the coil on these cores, and also on the armature coil when placed opposite them. When No. 2 circuit was excited the results show that in this case ν, the ratio of induction in limb to induction in armature = 1.21. In working out the characteristic curve for this motor the pole pieces at right angles to the particular circuit considered are neglected, and the following symbols taken to represent the different quantities involved:

l_1 the length of two cores in magnet winding	= 18.1 cm.
A_1 the area of one core	= 77.4 sq. cm.
l_2 half the mean length of ring	= 49.0 cm.
A_2 twice mean area of ring	= 97.0 sq. cm.
l_3 the length of air space	= 0.317 cm.
A_3 the effective area of one air space	= 87.1 sq. cm.
ν leakage coefficient	= 1.23 "
$\frac{m}{2}$ the number of turns per limb	= 102 "

Neglecting the armature, the equation to the characteristic curve is $\frac{4\pi m x}{10} = l_1 \frac{\nu I}{\mu_1 A_1} + l_2 \frac{\nu I}{\mu_2 A_2} + 2 l_3 \frac{I}{A_3}$ when I is total induction in armature in C. G. S. units.

If the characteristic curve be found in the ordinary manner it will be seen that almost all the force is spent in the air space. The curves in Fig. 3, after integration of $\frac{d I_1}{d t}$ $\frac{d I_2}{d t}$, and the characteristic curve, give the results shown in Table I.

When running light as above, it was found that the average rate at which work is done on the motor is 460 watts. When delivering 287 watts at the brake the average rate from supply circuits is 794 watts. This gives a net efficiency of 36 per cent. when loaded. The power taken to drive the armature without brake is considerable, owing partly to the brushes on the contact maker and collecting rings, in addition to bearing friction. The volume of stationary part of motor is about 6000 cubic centimetres; and with frequency 35 and max. $B = 6000$, the loss due to hysteresis alone, neglecting disturbance in ring due to $I_1 + I_2$, might be about 63 watts; about 50 watts are expended upon magnetizing coils, leaving about 350 watts for armature alone and induced currents in stationary part of motor. Then again the gain of field upon armature f_1—f_2, when measured as a direct quantity by a method to be described, showed that it was little less than half when running light, as compared with what it was when loaded. We are well aware that when loaded $\frac{4\pi m x}{10}$ is not the only magnetizing force acting, the currents in the armature must be taken into account; that is to say, the more we load the motor the greater should the inductions as given by the characteristic curve, taking $\frac{4\pi m x}{10}$ to be the only force acting, appear. We find this to some extent verified in Table I, but the reaction in this machine is not sufficiently great with maximum torque to give any

TABLE I.

	No. 1 circuit.				No. 2 circuit.				No. 1 and No. 2 circuits.	
	Observed maximum. $\frac{4\pi m_1 x_1}{10}$	Observed maximum. I_1	Characteristic curve gives		Observed maximum. $\frac{4\pi m_2 x_2}{10}$	Observed maximum. I_2	Characteristic curve gives		$\frac{I_1 + I_2}{2}$	$\frac{I_{1'} + I_{2'}}{2}$
			$I_{1'}$	B_1			$I_{2'}$	B_2		
Motor running light.....	2,610	0.412×10^8	0.848×10^8	6,790	3,000	0.466×10^8	0.437×10^8	5,640	0.439×10^8	0.442×10^8
Motor loaded	2,793	0.319×10^8	0.430×10^8	5,560	3,100	0.484×10^8	0.416×10^8	5,340	0.401×10^8	0.423×10^8

very definite results on this point, and the characteristic curve is approximate.

Referring again to the curves in Fig. 3, we note that the effect of increase of load is to reduce the phase difference between potential and current, the current being increased in amplitude. In this motor we note the large phase difference between potential and current, even when loaded as in the experiments. This is a point of practical importance, since the ratio $\frac{\text{apparent watts}}{\text{true watts}}$ in the transmission of power by alternate currents should be kept as large as possible. We see at once how small motors of this kind can be improved. The air space demands a large magnetizing current; but the dissipation

TABLE II. NON-SYNCHRONOUS TWO-PHASE MOTOR.

Curve 1.		Curve 2.		Curve 3.	
Alternator contact-maker in 60ths of a period.	Motor contact-maker in 60ths of a period.	Alternator contact-maker in 60ths of a period.	Motor contact maker in 60ths of a period.	Alternator contact-maker in 60ths of a period.	Motor contact-maker in 60ths of a period.
0	0	10	0	20	0
2·9	3	12·9	3	22·9	3
5·7	6	15·7	6	25·7	6
8·6	9	18·6	9	28·6	9
11·5	12	21·5	12	31·5	12
14·3	15	24·3	15	34·3	15
17·2	18	27·2	18	37·2	18
20·1	21	30·1	21	40·1	21
23·0	24	33·0	24	43·0	24
25·8	27	35·8	27	45·8	27
28·7	30	38·7	30	48·7	30

of energy due to hysteresis, induced currents, and friction when running light, is relatively small, and the only way to combine low dissipation with large currents is to have great phase difference. We find this automatically adjusted in this motor; and the obvious improvement consists in reducing the air-space length, or increasing the effective area of the air space. Of course, in large motors the dimensions are such as to improve the power factor, but this is not necessarily the case in small machines.

If f_1 be the frequency of supply in complete periods per second, f_2

the frequency of motor armature in complete periods per second, then $f_1 - f_2 = f$, the frequency of armature opposite in direction to impressed field. As this comes in as a direct quantity in what follows, it was desirable to measure it directly. If the motor armature loses $\frac{1}{n}$th part of a period per period on the field, then when each of the two contact-makers, that on the alternators and that on the motor make one contact per period, simultaneously contact will be made (*if f be constant*) by the two contact-makers every $n - 1$ periods of the generator. This is strictly true when n is a whole number, odd or even. It would only be necessary to place a D'Arsonval galvanometer and battery in the circuit of the two contact-makers in series, in order to count the number of contacts in a given time. It was found that f is not quite constant, and to make certain of contact

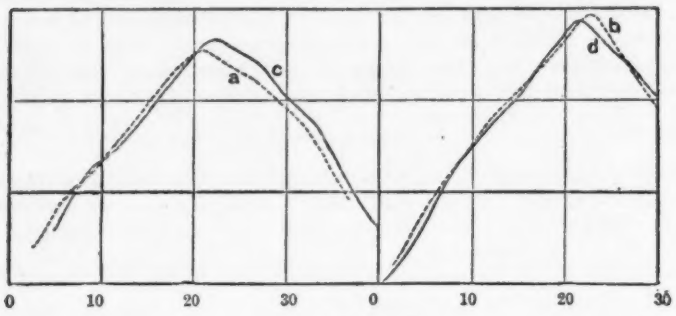


Fig. 3.

being made, the brush of the motor was widened so as to make contact for a longer fraction of a period. Suppose time of contact on motor be $\frac{1}{10}$th part of a revolution, the time on the alternator being small, one may say that with 2 per cent. slip two successive contacts might be made per 49 periods, but one contact is almost bound to be made. The brush on motor contact-maker was made to embrace an arc of a circle corresponding to $\frac{1}{3}$rd part of a period, and this was found to work well for all values of f_1 and f used.

The curves in Fig. 4 are interesting as showing the disturbance on the pole face itself of one of the magnet limbs. Two exploring coils were stretched over the surface, dividing it into about equal parts longitudinally. Curves $a\ b$ were observed on the two coils when the motor was running light; curves $c\ d$ when the motor was loaded, the conditions being as in Fig. 3. The curves $a\ c$ are given by the half of magnet pole face in direction of rotation; we see that loading the motor increases E. M. F. over the leading half of pole face, and decreases E. M. F. over the lagging half. The effect arises from the current in the armature conductors.

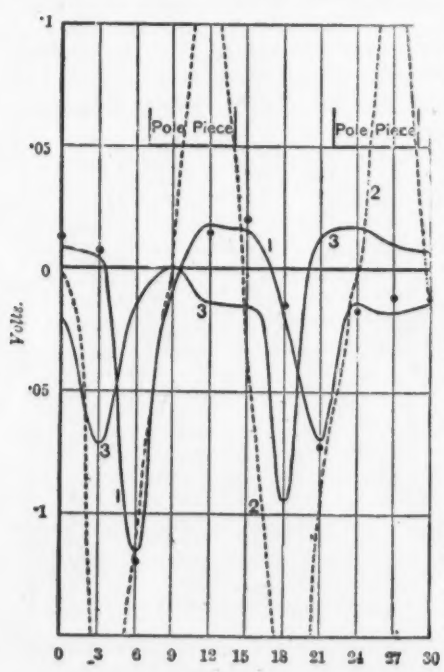


Fig. 5.

We now come to Fig. 5, which gives curves obtained from the exploring coil on the armature itself, while Fig. 6 gives the

$$\frac{d I_1}{d t} \quad \frac{d I_2}{d t}$$

curves and their integral curves, I_1 I_2, taken again because the conditions of running happened to be a little different to those in Fig. 3.

Let the two contact-makers and exploring coil on armature be placed in series with one another and with the quadrant electrometer, across which is placed a condenser of suitable capacity; ⅓ microfarad was used.

Let the motor be loaded and lose $\frac{1}{n}$th part of a period per period on the field. Choose any epochs you please to start with on the alternator and motor contact-makers; then, if we wish to systematically follow what goes on, it is clear that when the motor contact-maker has passed through one half period, that on the alternators will have passed through a half period *minus* $\frac{1}{2n}$th part of its period, and so on. In Fig. 5 the motor was loaded with an effective weight on the brake of five pounds. The frequency f_1 was 25, and f was observed directly to be 1.1; that is, the motor armature loses 4.4 per cent. of a period per period on the field. The alternator and motor contact-maker scales have each 60 divisions to the period. In Fig. 5 there are three curves numbered 1, 2, 3, and the simultaneous setting of the two contact-makers when observing these curves is set forth in Table II., the setting being divided proportionately into smaller intervals where the peaks occur on the curves.

The curves in Fig. 5 constitute a true test as to the field actually experienced by the armature when loaded. If we had in this motor a perfectly uniform field of constant intensity rotating at constant speed, and if the rate at which the field overtakes the armature be also constant, we should get simple sine curves instead of those in Fig. 5. In this machine the field is jerky, the leakage is great, and the quantity f is not quite constant.

We ought to be able from the curves in Fig. 5 to infer the force acting upon the armature producing torque; and since we can form a good idea of the actual work done in a given time by the armature upon brake, bearing and other friction, we should be able to directly compare these two quantities.

Let l be the length of the conductors in armature = 15¼ cm, B be the induction per square centimetre, r be the radius of conductors in armature = 5.75 cm, R be the resistance of one conductor in ohms = 0.00018: the resistance of each of the tubular conductors = 0.00036 ohms. This takes no account of soldered joints, the resistance being estimated.

Let E be the observed volts per turn at any epoch, as given by the exploring coil on armature.

Let x be the current in the armature conductor in amperes at the same epoch. We neglect the effect of the copper rings at each end of armature.

We have

$$x = \frac{E}{2R};$$

and we assume

$$\frac{E}{2} = l\, 2\pi r f \text{ B } 10^{-8}.$$

The force of the armature at radius r, due to the current in one conductor, is

$$\frac{\text{B } l\, x}{10} \text{ dynes} = \frac{E^2\, 10^7}{8\pi R r f\ 981\ \ 454} \text{ pound.}$$

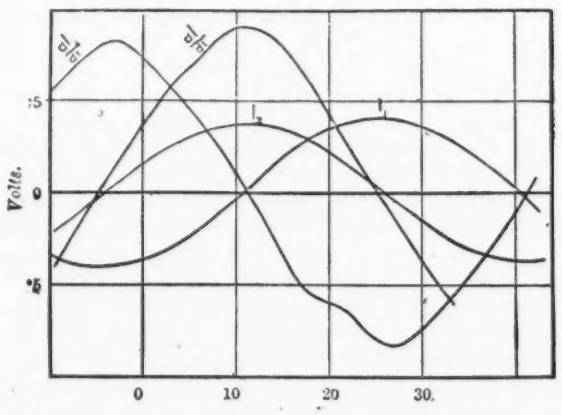


Fig. 4.

The ordinates of the curves in Fig. 5 have been squared, and their average taken for a half period. They are as follows:

Curve 1, average $E^2 = 0.0016$.
Curve 2, average $E^2 = 0.0160$ uncertain.
Curve 3, average $E^2 = 0.0010$.

The average force for a half period (periodic time $= \frac{1}{f}$) for the 24

conductors is as follows:

Curve 1, average force = 30.4 pound.
Curve 2, average force = 304.0 pound uncertain.
Curve 3, average force = 19.0 pound.

We have 5.5 pounds due to brake if we correct for radii of pulley and armature conductor, and the motor is evidently doing considerable work when running without brake, since f in this case $= \frac{1}{2}$. We may say that the average force in pounds acting on the armature at radius r should not be more than 10 pounds, and this is lower than any of the figures given above. These curves have been determined again, and the points marked ⊗ in Fig. 5 show the result in the case of No. 1. No. 2, as before, exhibited great instability, and the results obtained from it are not trustworthy. It must, however, be remembered that the three curves in Fig. 5 only give a rough idea of the average results given by the 22 sets of such curves required before similar events practically begin to happen. There is also no doubt but that the torque varied considerably, its periodic time being about one second; at these intervals the motor vibrated as though it were experiencing very great stress, and then settled down with perfect regularity.

The conclusions we draw from these experiments are that in these motors it is of vital importance to have a uniform field of constant intensity impressed upon the armature, specially on load, and of course due notice must be taken of the currents in the armature conductors. If this is not the case terms are introduced having different periodic times to the main effect, giving rise to variable torque and inefficiency. It seems hardly worth while to discuss fully the comparison of the curves in Fig. 5 with those in Fig. 6, since the leakage is so considerable, but it is worth noting that max I_1 and I_2 in Fig. 6 are 0.536 and 0.497 $\times 10^6$ C. G. S. units respectively. The maximum I, as given by the curve 1 in Fig. 5, for instance, is 0.488 $\times 10^6$. The mean of 0.536 and 0.497 multiplied by $\sqrt{2}$ gives 0.723 $\times 10^6$, and this would be the maximum induction impressed on the armature by the poles if there were no leakage and no effect from armature currents. In Fig. 1 the numerals 0 to 30 indicate the position of the exploring coil with regard to the poles in Figs. 5 and 6. Take curve 1, Fig. 5. When the coil on armature has position 17 its E. M. F. is zero, and at this epoch the curves I_1 I_2, Fig. 6, would indicate roughly a maximum induction. Take curve 3, Fig. 5. The armature coil has at position 17 considerable E. M. F. The curves I_1 I_2, Fig. 6, would at position 36 indicate roughly a very small total induction.

Sets of curves similar to those in Fig. 5, the motor running light, were obtained; but in each case the instability was so great as to render them of little value for quantitative results. The author hopes before long to place this same armature in a more uniform rotating field, and thereby get conditions in which the subject is much easier to handle.

Development of Prof. Bell's Radiophone.

It is reported that Prof. Alexander Graham Bell is devoting his attention to the commercial development of his "radiaphone," which he devised nearly 20 years ago. In this instrument he utilizes a beam or ray of reflected light for the transmission of sounds between distant points in lieu of the ordinary wire.

The transmitter is made up of a thin diaphragm of mica or of some other similar substance, silvered at its back so as to make of it a reflecting mirror. The diaphragm is connected with an ordinary speaking tube, into which the operator talks just exactly as he would talk into the transmitter of a telephone. Against this thin disc or diaphragm is projected a ray of light, preferably sunlight. The light is caught by a mirror, and directed through a concentrating lens whose focus is the transmitting diaphragm. The latter in turn reflects the ray through a second lens, which again makes the components of the ray of light parallel, so that it may travel any distance without dispersion.

At the receiving station there is a parabolic reflector, at the end of which is fixed a selenium cell. The cell in turn is connected, telephonically, with the ear. When the ray of light is reflected from the transmitting diaphragm and the operator speaks into the tube joined with the latter, what he says may be clearly and distinctly heard at the other end of the line, that is, at the other end of the traveling ray of light.

Theoretically it is entirely conceivable that if a series of mirrors were set up at regular intervals, sufficient to overcome the curvature of the earth, it would be possible to talk across the continent, or for that matter, were the way clear, all around the world, with this single original beam of light.

The Efficiency of Pelton Water-Wheels.

BY F. K. BLAUE.

The widespread use and great popularity of the Pelton water-wheel, especially in countries where considerable heads of water are available, seems to make it desirable that there should be a more complete presentation of its theory as far as relates to its practical employment in the exploitation of water-powers.

It is well known that the Pelton wheel gives a very high efficiency, 86 per cent. being the average result in ordinary practice, and even higher in many cases.

A recent test made on a wheel running at the North Star mine in Grass Valley, Cal., showed the phenomenal efficiency of 93 per cent. at full load and an average of 90 per cent. at one quarter, one half, and three quarter load. The wheel referred to is 18 feet in diameter, runs under 750 feet head at 110 revolutions and develops some 300 horse-power. It is connected to the shaft of a duplex compressor and was made of this large diameter to give it proper speed by direct connection.

The exceptional diameter of the wheel in this case has little to do with its efficiency, equally good results having been obtained on these wheels of much smaller diameter.

With all the varying conditions under which wheels are operated, there are occasionally met with some cases which are unfavorable for securing the best useful effect. For example, with a low head and a large quantity of water, or where the power developed is very small in comparison to that for which the wheel was designed, a lower efficiency must be expected.

It frequently happens, however, that the loss is found to be due to defects in connections or setting, in which case the difficulty may be readily overcome.

In making experiments to aid in locating these faults it is necessary that they should be made as accurately as possible and under various conditions. Any number of tests under the same conditions will show nothing with regard to the cause of a low efficiency, but when accurate readings are taken under as many different speeds and heads and sizes of nozzle as possible, even though the amount of power delivered be determined indirectly, an idea of where the fault lies can often be formed at once by plotting these values and observing the nature of an approximate curve drawn through them. The following discussion of the theory of the Pelton water-wheel will indicate some of the methods by which this may be done.

The symbols and some of the formulas employed in this discussion are here placed together for convenient reference and will generally be used without further explanation:

$\sqrt{2g} = 8.019$.

γ = Weight of one cubic foot of water = 62.355 lbs. (at 62° F.).

Q = Quantity of water in cubic feet per second $= .0434\, c\, d^2 \sqrt{h}$.

q = Quantity of water in cubic feet per minute $= 2.625\, c\, d^2 \sqrt{h} = 3.99\, c d^2 \sqrt{p} = \frac{529\, L_H}{Eh} = \frac{229\, L_H}{Ep}$.

v = Velocity of jet in feet per second $= C_v \sqrt{2gh}$.

w = Velocity of water-wheel vane along the centre line of the jet in feet per second $= .0087\, sn$.

h = available head in feet of water behind the nozzle $= 2.31\, p$.

p = pressure head behind the nozzle in lbs. per sq. in. $= .433\, h$.

d = diameter of circular orifice of nozzle in inches.

$$d^2 = \frac{201.6\ L_H}{E\, c \sqrt{h^3}} = \frac{57.46\ L_H}{E\, c \sqrt{p^3}} = .381 \frac{q}{c\sqrt{h}} = .251 \frac{q}{c\sqrt{p}}$$

θ = average angle in radians through which the direction of the jet is changed in passing over the bucket vanes of the water-wheel.

L = power received by the revolving buckets from the jet of water in ft. lbs. per. sec.

L_H = useful horse-power delivered by the water-wheel = .00189, $E\, q\, h = .00436$, $E\, q\, p = .00496$, $E\, c\, d^2 \sqrt{h^3} = .0174\ E c\, d^2 \sqrt{p^3}$.

L_f = frictional losses, of power, which are in direct proportion to the speed of the water-wheel in ft. lbs. per sec.

c_v = coefficient of velocity; the ratio of the actual velocity of the jet to its theoretical velocity as determined from the available head back of the nozzle.

c = coefficient of discharge from orifices; the ratio of actual to theoretical quantity of water discharged from the nozzle. An average taken from a number of experiments from various sources give .90 as an approximate value of c.

C_f = coefficient of friction, $= \frac{15\sqrt{2g}\,r}{e\gamma q\sqrt{h}\,s}$ F = the constant force of friction, F, multiplied by constants with regard to a change of speed to give it the same form as c_v.

C = apparent coefficient of velocity with regard to useful power delivered by the wheel.

e = coefficient of design, some function of $\frac{1-\cos\theta}{2}$.

K = coefficient of nozzle; this may be taken equal to 2.36 a for ordinary Pelton nozzles when the quantity of water cannot be measured in any other way.

s = distance from centre line of jet to axis of wheel in inches.

n = number of revolutions of wheel per minute.

$\bar{n}$ = number of revolutions per minute of wheel at best speed with regard to useful power delivered.

r = length of brake lever arm in inches.

P = pounds pull on brake lever arm at distance r.

μ = ratio of twice the velocity of the buckets at the centre line of the jet to the theoretical velocity of the jet as determined from the available head of water behind the nozzle.

Z = ratio of the torque measured by the brake, or calculated from the useful power delivered to that which would be derived from the total available power of the water behind the nozzle.

E = ratio of power delivered by wheel to total available power of water behind the nozzle; efficiency of the water-wheel at any speed.

ϵ = ratio as above at best speed with regard to useful work; maximum efficiency of the wheel.

Let us take the usual formula for the power exerted by a jet of water upon a series of revolving vanes, $L = \frac{rQ}{g}(v-w)\,w\,(1-\cos\theta)$. Substituting in this equation $v = c_v\sqrt{2gh}$ and $\mu = \frac{2w}{\sqrt{2gh}}$ and putting e (for the present) equivalent to $\frac{1-\cos\theta}{2}$ we have a form more suitable for our present use, $L = \gamma\,Q\,h\,(2\,c_v\,\mu - \mu^2)\,e$. Then since the power of the water is $\gamma\,Q\,h$ the hydraulic efficiency of the wheel would be $(2\,c_v\,\mu - \mu^2)\,e$. But the practical efficiency of the wheel based upon the actual power transmitted by it will be reduced by friction in the journals. It may therefore be written $E = \frac{L - L_f}{\gamma\,Q\,h}$.

Since the work due to this friction is proportional to the speed of the wheel, we may for convenience arbitrarily put $L_f = \gamma\,Q\,h\,2\,C_f\,e\,\mu$ in which C_f will be a coefficient of friction corresponding to c_v, the coefficient of velocity of the jet. Substituting this value and reducing to the same form as for hydraulic efficiency, we then have $E = (2\,[c_v - C_f]\,\mu - \mu^2)\,e$. Putting $C = c_v - C_f$, this may be more conveniently written $E = (2\,C\,\mu - \mu^2)\,e$.

If the mean angle of discharge, θ, and the losses by friction in the buckets, were the same at all speeds of the wheel, or, in other words, if e was a constant for all speeds, a tracing of this equation would give us a curve of efficiency with regard to the speed of the wheel. Now, for practical purposes of estimating the maximum efficiency and corresponding best speed of the wheel from observations, e may be thus taken as a constant coefficient which is some function of, but must not be regarded as, equal to $\frac{1-\cos\theta}{2}$.

This curve of efficiency may be approximately found from observations by tracing it through the values plotted from the equation $E = \frac{\pi\,r\,n\,P}{6\,\gamma\,q\,h}$. The calculation of this efficiency from observations may be facilitated by the use of two constants. For each size of nozzle used a coefficient of discharge may be found by taking the average of several observations of the quantity of water issuing from the nozzle divided by the square root of the head under which it flows. This will give us $K = \frac{q}{\sqrt{h}}$. Then for each nozzle used we may put $K_E = \frac{\pi\,r\sqrt{h}}{6\,\gamma\,q} = \frac{\pi\,r}{6\,\gamma\,K} = .0084\,\frac{r}{K}$, and our efficiency for each observation of speed, weight and head would be $E = K_E\,\frac{n\,P}{\sqrt{h^3}}$.

For purposes of comparison, it is most convenient to plot these values as ordinates with the corresponding values of μ as abscissæ which may be calculated by the formula $\mu = \frac{s\,n}{460\sqrt{h}}$, but each set of observations thus plotted should not contain any considerable variation in head.

For practical purposes we may take $E = (2\,C\,\mu - \mu^2)\,e$ as the form of the equation of the curve traced through the mean values of E until μ = about 1.1, when, on account of a portion of the water passing through the wheel without entering the buckets, the equation of the curve takes the form $E = [4C^3\,\mu - 4C\mu^3 + \mu^3]\,e\,x$ which involves difficulties that render it of little value for practical use. The tracing of the curve for the former equation should therefore be confined to those values of E for which μ is less than about 1.1.

The highest point in this mean curve of efficiency will now indicate the maximum efficiency of the wheel under the given conditions and the corresponding best speed of the wheel at which this efficiency can be obtained.

This best speed for practical efficiency will always be less than that for the highest hydraulic efficiency, but as it is this efficiency that represents the useful work that may be realized from the wheel, it is this speed that must be considered when the greatest economy is desired in the employment of these wheels. If we find the values of C and e, which, substituted in the above equation, would give the mean curve drawn through the plotted observations, then the best speed for maximum efficiency will be when $\mu = C$, and the corresponding maximum value of E, which we now denote by ϵ, will be $\epsilon = C^2 e$.

The value of C and e may be most conveniently obtained by plotting the ratio of the torque, measured by the brake, to that which would be derived from the total available power of the water behind the wheel, if applied to the same lever arm. Let us denote this ratio by Z and we will have:

$$Z = \frac{E}{\mu} = 2\,eC - e\,\mu = \frac{30\sqrt{2g}\,rP}{\gamma\,s\,q\sqrt{h}} = \frac{30\sqrt{2g}\,rP}{\gamma\,s\,K\,h} = K_s\frac{P}{h} \text{ and } K_s = \frac{30\sqrt{2g}\,r}{\gamma\,s\,K} = 3.858\,\frac{r}{s\,K}$$

We now have a quantity whose observations plotted according to the corresponding values of μ should fall in a straight line, the constants of whose equation are made up of the coefficients C and e, which we are seeking.

To find the most probable values of these quantities, then, we have to plot the values of Z for a number of observations at various speeds of the wheel, with regard to the corresponding values of μ, which should be less than about 1.1. Then draw a straight line to represent the mean values of Z and extend it until it meets the coordinate axes of Z and μ. Now let Z_o be the value of Z given by this line when $\mu = o$ and μ_o be the value of μ when $Z = o$. Then we have $e = \frac{Z_o}{\mu_o}$, $C = c_v - c_f = \frac{\mu_o}{2}$, and $\epsilon = C^2 e = \frac{\mu_o\,Z_o}{4}$. We thus find that the maximum efficiency ϵ will be obtained when the wheel runs at its best speed, which is $\bar{n} = \frac{460\,C\sqrt{h}}{s}$, h being taken at the average of the values given in the observations.

From these equations we thus readily see that the best speed of the wheel with regard to maximum useful work to be derived from it does not correspond to the best speed for maximum hydraulic efficiency, but will be less according as the efficiency with regard to useful work is less. From the foregoing equations we have $C = \sqrt{\frac{\epsilon}{e}}$. Now, e will not in any case vary greatly either side of unity, so for practical purposes we may multiply the best speed with regard to available head by the square root of the efficiency with regard to useful work to find the corresponding best speed for the maximum useful power to be derived from the wheel. When we know this efficiency we may then in practice take for the best speed of the wheel $\bar{n} = \frac{460\sqrt{\epsilon\,h}}{s}$.

For convenience in calculating from observations when the head of water is measured by a hydraulic gauge reading in pounds per square inch, the foregoing equations are here repeated with additional values in terms of p:

$$K = \frac{q}{\sqrt{h}} = .6657\,\frac{q}{\sqrt{p}}$$

$$K_z = 3.858\,\frac{r}{sK} \qquad k_z = 1.671\,\frac{r}{sK}$$

$$K_E = .0084\,\frac{r}{K} \qquad k_E = .00239\,\frac{r}{K}$$

$$\mu = \frac{2\,w}{\sqrt{2\,g\,h}} = \frac{s\,n}{460\,\sqrt{h}} = \frac{s\,n}{690\,\sqrt{p}}$$

$$Z = \frac{E}{\mu} = 2\,e\,C - e\,\mu = 3.86\,\frac{r\,P}{s\,q\,\sqrt{h}} = 3.86\,\frac{r\,P}{s\,K\,h} = K_z\,\frac{P}{h} =$$

$$1.67\,\frac{r\,P}{s\,K\,p} = k_z\,\frac{P}{p}$$

$$E = \frac{L - L_l}{\gamma\,Q\,h} = \mu\,Z = (2\,C\,\mu - \mu^2)\,e = \frac{\pi\,r\,n\,P}{6\,\gamma\,q\,h} = .0084\,\frac{r\,n\,P}{q\,h} =$$

$$.0084\,\frac{r\,n\,P}{K\,\sqrt{h^3}} = K_E\,\frac{n\,P}{\sqrt{h^3}} = .00239\,\frac{r\,n\,P}{K\,\sqrt{p^3}} = k_E\,\frac{n\,P}{\sqrt{p^3}}$$

$$e = \frac{Z_0}{\mu_0},\quad C = c_v - c_l = \frac{\mu_0}{2},\quad \varepsilon = C^2\,e = \frac{\mu_0\,Z_0}{4}$$

$$\bar{n} = \frac{460\,C\,\sqrt{h}}{s} = \frac{690\,C\,\sqrt{p}}{s}$$

As a practical illustration of this method of calculating the maximum efficiency, suppose we have a 2-inch nozzle throwing a jet whose centre line is 30 inches from the axis of revolution of the buckets and we measure the power by a Prony brake whose lever arm is 63.03 inches long. From a number of readings at the measuring box and corresponding observations of the pressure gauge, we find the average value of $.6657\,\frac{q}{\sqrt{p}} = K$ to be 9.06. This value may have been obtained from a set of readings as taken from a pressure gauge and standard miner's inch measuring box as follows:

Gauge Pressure.	Miner's Inches.	Cu. ft. per Min.	$.6657\,\frac{q}{\sqrt{p}}$
p	m	q	K
94	90	134.2	9.07
102	96	143.1	9.3
108	97	144.8	9.13
108	95	141.7	8.93
96	94	140 2	9.39
			5)45.82
			9.06—Average value of K.

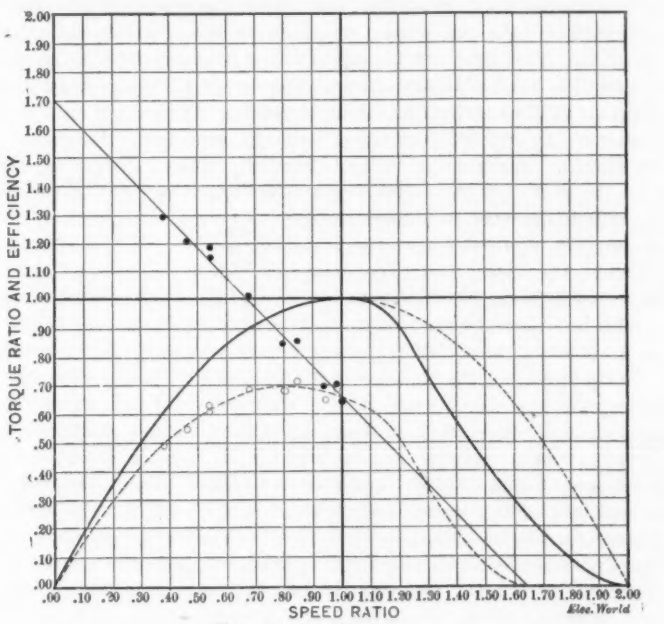
Hence $k_z = 1.671\,\frac{63.03}{30 \times 9.06} = .388.$

Now if in the brake test we get readings from the pressure gauge, the speed counter and the weight on the lever arm, as illustrated in the first three columns of the following table, we may calculate the value of μ and Z from the formulas, $\mu = \frac{30\,n}{690\sqrt{p}} = .0435\,\frac{n}{\sqrt{p}}$ and $Z = k_z\,\frac{P}{p} = .388\,\frac{P}{p}$, which will give the values shown in columns IV and V. These values of Z may now be plotted as ordinates to the corresponding values of μ as in the diagram. A straight line drawn through the mean values and extended till it meets the axes of coordinates, gives as $Z_0 = 1.7$ and $\mu_0 = 1.64$. From this we readily find the apparent coefficient of velocity, $C = \frac{1.64}{2} = .82$, the coefficient of design $e = \frac{1.7}{1.64} = 1.036$, and the maximum efficiency at best speed is $\varepsilon = \frac{1.64 \times 1.7}{4} = .697$. The equation of the line is $Z = 1.7 - 1.036\,\mu$. The speed at which the highest efficiency, .697, is attained is $\bar{n} = \frac{690 \times .82 \times \sqrt{100}}{30} = 189$ for 100 pounds per square inch pressure.

The low value of C shows that there is a very considerable loss by some constant force of friction. The value of e being greater than one shows that the efficiency of the water is greater the nearer the buckets are to the nozzle, which may be on account of the design of the buckets, their number, or the spreading of the jet as it passes through the wheel.

The efficiency of the wheel for each reading, which may be obtained by taking the product of μ and Z in columns IV. and V. is given in column VI., and is shown by the circles plotted in the diagram.

This diagram also shows the theoretical curve of efficiency for a Pelton water-wheel with regard to its speed if there were no losses of any kind. In this case the maximum efficiency would be attained when the velocity of the bucket at the centre line of the jet was just one half the velocity of the jet. The sudden change in the form of the curve when μ is about 1.1 is because a part of the jet commences to pass through the wheel at about this speed without touching any of the buckets. This curve shows that the speed of the wheel can be varied considerably, especially below the point of maximum efficiency, without causing any very serious loss.



EFFICIENCY CURVES.

Since E is the product of μ and Z it may be readily seen that if a set of values of the efficiency E be obtained in any manner with the corresponding values of head and speed, and it is desired to find the most probable maximum efficiency ε in the manner described above, this may be easily done by dividing each value of E by the corresponding value of μ calculated in the usual manner which will give the corresponding values of Z. Then we may plot these values of Z and so find the value of ε as in the above illustration.

TABLE OF OBSERVATIONS.

I.	II.	III.	IV.	V.	VI.
p.	n.	P.	μ.	Z.	E.
103	234	173	1.00	.65	.65
"	219	186	.94	.70	.658
"	229	"	.98	"	.686
105	189	230	.80	.85	.682
"	198	"	.84	"	.714
96	153	250	.68	1.01	.687
"	122	284	.54	1.15	.622
"	122	292	.54	1.18	.637
"	104	299	.46	1.21	.557
100	86	335	.38	1.30	.496

India's Caoutchouc Trees.

Great Britain, ever intelligently alive to her material interests, has undertaken the growing of caoutchouc trees on a large scale in British India for the reason that the forests there were exhausted, just as they have been elsewhere. Many years ago a goodly fraction of the world's supply (which was much smaller then than now) came from the British provinces in India, and the gum from them was the best in quality that came to the market. It was large enough to make England miss the revenue from it, and when the supply practically ceased the home Government undertook to restore it. As to the methods employed and the measure of success attained little or nothing is known in this country, but nowhere else in the world, so far as is known to the trade here, has any similar effort been made.

Riding on Crowded Cars.

BY R. D. FISHER.

"So long as passenger carriers in a crowded city deliver and encourage the method of crowding cars in the transportation of persons, the rule of law which demands the highest degree of diligence on the part of the carrier must not be relaxed," says Justice Shepard, of the Illinois Appellate Court, in affirming the judgment of the trial court in awarding damages to the amount of $2500 for a personal injury inflicted while riding on the footboard of a crowded car. The overcrowding of cars has become a common practice, and one fruitful of results leading up to costly litigation. It is a practice exceedingly difficult to prevent in the absence of strictly enforced public regulations, and has become so universal that courts, except in extreme cases, have hesitated to consider such a practice one of culpable negligence on the part of the company to permit or encourage it. The privilege of standing upon the platform, running boards or in the aisles of a crowded street car has so long been regarded by the public as far more preferable than to wait for another car that it cannot be said to be negligence *per se* on the part of the passenger to take passage on a car already crowded. The law declares that a passenger is not required to exercise extraordinary care for his own safety, but all that is required of him is that he should exercise such ordinary care and prudence as ordinarily prudent persons would exercise under like conditions. A passenger who voluntarily takes passage by invitation, impliedly or otherwise, upon a crowded car, has no reason to apprehend disaster to himself unless it be from the jostling of the passengers against each other, and in such event the passenger assumes the risk of all such dangers. As a rule, when accidents occur under such circumstances, the negligent act of the company would be offset by that of the passengers. But the modern and common practice, whether from greed or necessity, of undertaking to carry more passengers than can safely sit or stand within the cars and upon the platforms and steps, will generally authorize the submission to the jury, in case of an action for damages, of the question of the carrier's negligence in permitting its cars to be overloaded. A passenger on a crowded car does not assume risks from injuries caused by the negligent management of the cars in other respects. Therefore, where a company permits its cars to become so crowded that passengers are compelled to ride on the footboards and attempts to move or run them in that crowded condition by other cars, vehicles or obstructions which cannot be passed without a collision and injury to passengers, such company, in the light of authority, may be adjudged guilty of culpable negligence, and the result of which overcrowding the risk assumed by the passenger cannot be relied upon as a defense. The fact that one voluntarily takes passage and assumes such a position, because there is no better, will not preclude a recovery for the negligent management of an overcrowded car, nor will the wrongful act of passengers, who in their reckless haste to leave the car, throw another to the ground and injure him, relieve the company from the consequences of overcrowding its car and failing to control its passengers.

A passenger, under the common practice of operating crowded cars, may ride standing upon the platform or footboard of a car, without being guilty of negligence, for all that is required of such passenger to do is that which would ordinarily be done under like circumstances by an ordinarily careful person to avoid being injured.

Therefore, as a matter of law, a carrier of passengers in a crowded city who tolerates and encourages the practice of crowding its cars in the transportation of people, is held to the highest degree of diligence, and this means quite if not all the risk of injury that may come to the passengers thereof.

A street railway company has a right to make all reasonable rules and regulations conducive to the safety and comfort of passengers, and as riding on the platform and footboard of a crowded car is obviously attended with danger, as well as interfering with its management by the servants, or the movements of those who wish to enter or leave a car, a rule preventing the practice of riding on such platform or board has been held by many courts both wise and reasonable. But a new placard posted in the car, notifying all persons that they are forbidden to ride on the front platform or footboard, and that the carrier will not be responsible for their safety while riding there, will not avail very much against the practice of allowing cars to become burdened to every inch of standing space. A motorman, notwithstanding his car may have the superior right of way, is bound to so manage his car in speed or otherwise as to avoid imminent danger from collision with vehicles or obstructions on the street. This is true, even if the driver of the private vehicle is careless, and unless the car is managed with the highest degree of care to avoid the collision under such circumstances, the company will be held liable. So it will be seen, by an examination of the authorities, that if a passenger on a crowded car, without his fault, is injured in any way, due to the negligence of the management, or to defective cars, tracks, bridges or illegal speed, the company is liable. If a company may regulate the manner of entering and leaving a car, or provide a regulation against riding upon the platform except at the passenger's peril, would it not be advisable to regulate the number of passengers to be carried upon a particular car? To do so in crowded cities would not give satisfaction to the public unless an ample number of cars were provided, yet it would not decrease the revenue in proportion to the increased expense in providing such cars. That street railway companies pay large sums in judgments awarded for injuries occasioned by reason of overcrowded cars is evident, and whether this outlay would be obviated and saved to a company by an iron rule of law which would prevent the crowding of any car is a question we have no means or statistics at hand to assist us in formulating an answer. Judging, however, from the disposition upon the part of companies to take chances on the safe transportation of passengers by the crowded method, a regulation limiting the capacity of a car would not only be annoying and fruitless, but also have a tendency to curtail the net receipts of the company. How long the crowded method of transportation will be endured depends upon the angelic disposition of the people, who, more than ever before, are demanding that franchise rights provide for both comfort and capacity in the method of carrying passengers. In case there is ample room within a car, passengers who voluntarily ride on the platform or on the running board and suffer injury are liable to defeat a recovery for damages. In order, however, to avoid the charge of negligence on the part of the company, the latter is bound to provide a safe and comfortable place within the car for passengers or refuse to allow them to get aboard an overcrowded car.

The Ashtabula Rapid Transit Company.

This company is a good example of a money-making concern using pioneer electric railway apparatus and equipments. Ashtabula consists of two distinct portions which are thickly settled. One of these is known as The Harbor and is down on the lake front, and the other is the town proper, some five or six miles inland. Between the two portions of the town runs the Lake Shore Railroad. The Ashtabula Rapid Transit Company's lines connect the harbor

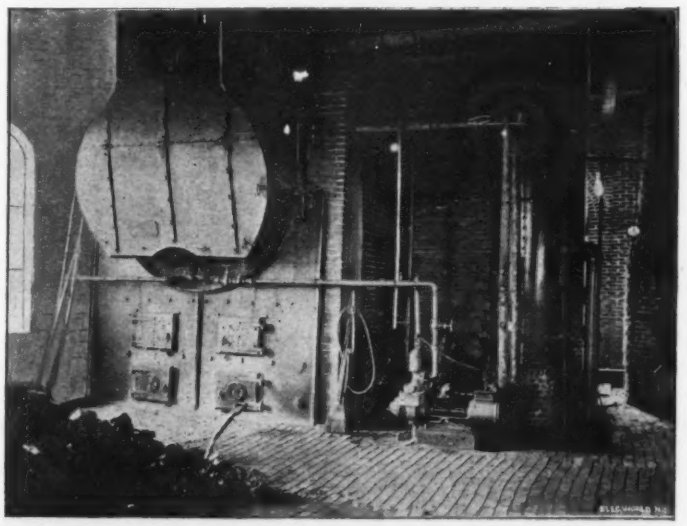


FIG. 1.—BOILER ROOM.

with the town proper, and also afford transportation to the Lake Shore depot. The station is located about half way between the town and the harbor, and is a brick building having also a brick stack. The roof is a wooden trussed affair, but is strong and weatherproof, and the station is well adapted for its purpose.

Coal is supplied to the station by means of a railway switch, a whole carload being available at a time. The coal is soft and about two and a quarter tons per day are consumed.

There are two boilers. One a Manning verticle boiler of about 100 horse-power, which is little used, and the other a 200-hp horizontal boiler. This latter boiler is 7½ feet in diameter and 16 feet long and contains 118 four-inch flues. It is fed by city feed water taken from the lake; this water contains considerable lime, deposits of which form a hard and troublesome scale. By frequent blowing off and the use of Emerald boiler oil the boiler is kept clean, but considerable quantities of scale are removed at every cleaning. Both boilers have the customary brick setting. The steam pressure is from 70 to 75 pounds and passes into a single system of steam piping covered with magnesia and banded, to the engines.

There are two engines, one of which is a Russell four-valve engine with a Tangye bed and large fly-wheel running at 180 revolutions per minute. The cylinder dimensions are 14 x 20 inches. It is lubricated by sight-feed oil-cups and mounted on a brick foundation, no sub-base being used. This machine is belted directly to a Thomson-Houston bipolar railway generator. This generator runs at 500 volts and is compound for constant potential at the bus-bars according to the old method of railway operation. The Russell engine is rated at about 100 horse-power. The dynamo runs at 900

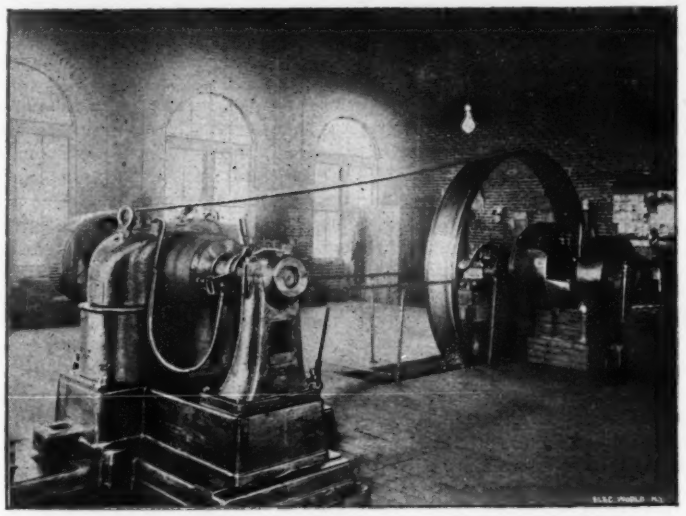


FIG. 2.—DYNAMO ROOM.

revolutions per minute. A precisely similar generator is driven by a Buckeye engine having 13 x 21 cylinder dimensions and also running at 180 revolutions per minute. This is a two-valve engine and has a separate eccentric to drive the cut-off valve. The Russell engine and its generator may be seen in Fig. 2. These generators run in multiple and have an equalizer wire which is connected on the middle terminal of a three-pole switch and therefore the positive and negative equalizer connections are made simultaneously.

The switchboard is of wood and is provided with Thomson-Houston ammeters and a Thomson-Rice voltmeter. There are two feeders and two circuit-breakers. The engine exhausts into a Stilwell heater, from which the feed water is drawn by two feed pumps connected to the boilers.

The road, as has been before stated, is from five to six miles in length, and is laid with a Johnson girder rail, which is both bonded and cross bonded. Brill cars are used and also Brill trucks. The motors are Thomson-Houston and also General Electric. The overhead construction is mostly hung from side poles by means of brackets.

The motormen and conductors are mostly young, some of them being mere boys. It remains to be said, however, that they seem to do excellent service, and accidents are fully as rare as if the employees were more mature. The road has been in operation for four years, and has been remarkably successful.

Compressed Air Traction.

To the Editor of The Electrical World:

SIR:—On page 139 of the Aug. 1 issue of THE ELECTRICAL WORLD appears an article descriptive of the "Hardie Compressed Air System," which is fairly accurate so far as it goes; but on page 126 there is an editorial which is unjust and incorrect so far as compressed air is concerned. It is natural that an electrical journal should look at the subject from an electrical standpoint, and that they should be much exercised over the success of the compressed air motors.

In making a comparison between electricity and compressed air the broad assertion is made at the outset that "there can be no doubt in their present respective conditions as to which such a comparison must favor." Observe that care is taken to compare "present respective conditions," which are, that compressed air is trying to get a foothold, and electricity has the field; electricity behind the ramparts, and compressed air storming the fortifications. What electricity has to fear most is, that compressed air will get a foothold. After that, surrender is inevitable. To say that "the compressor and the compressed air motors can never approach, under commercial conditions, the efficiency comparable with electric machines' is untrue, and who ever made the statement does not thoroughly understand both sides of the question. Neither is it true that "the trolley system is simpler and has fewer parts to maintain in working order." It is true "that electric motors produce a uniform torque and tractive power;" in this there is a slight advantage, but it is very far from the truth to say that electric traction is less severe on the track construction, for an electric motor must necessarily be as heavy as for any steam track lines, where locomotives weighing 60 tons and over have to be carried. Any properly built street railway will carry a spring-supported air motor without underground construction of any kind or overhead wires, while the electric motors not only require overhead or underground construction, but also require a roadbed and rail sufficiently heavy to bear the heavy pounds of rigidly carried loads. Stress is laid on the fact that compressed air motors have to be recharged. This is an operation which takes less time than it takes a locomotive to take water and coal, and shows the little straws that electricity is clutching onto in order to save itself. It is in the same line to say that "electricity has stood the test of practice," considering that until the present test on 125th Street compressed air has not had that opportunity. It is admitted that compressed air has the advantage "that each unit is independent, and that no overhead construction is necessary." This is saying a great deal, and is just the advantage which outweighs all other disadvantages. It is further stated that "it may be operated on any permanent way," but adds, "where the roadbed has received the necessary attention." What "necessary attention" is required more than is necessary for a good horse-car track? There is no more reason for the statement that compressed air is "liable to be exhausted on any part of the line" than there is for a steam locomotive to get out of water and coal. In both cases there is a margin to ensure the completion of the trip, while in the case of an electrically-equipped line it is possible for the entire electrical service to break down, stopping all the cars at one time. The writer goes on and endeavors to show that the "heat losses" must be great, but it is clear that he does not understand whereof he speaks, as the facts are almost the reverse of his deductions. He says "the possibilities of electric traction, on the other hand, have by no means attained their limit," which is another way of stating that "electricity is still in its infancy." When compressed air has grown to the same maturity as electricity and has had as much money and brains spent upon it, it will be in general use for street-car traction.

NEW YORK CITY. ROBERT HARDIE.

[The spirit of enthusiasm and confidence displayed by Mr. Hardie are not only commendable but are among the most essential elements in attaining success in any undertaking. If therefore there exists any possibility of the successful application of compressed air for traction purposes, we may with confidence look to Mr. Hardie for its final achievement. Among the several points contained in the editorial to which he refers, those which he has deemed worthy of consideration have certainly not been disproved by the statements which he makes. We must therefore not only adhere to our previous opinions but strengthen our position by adding that the connecting rod, an absolutely essential feature of the compressed air motor, has long since been tried and abandoned as impracticable in electric traction. As to the use of springs for supporting the air-motor, thereby overcoming the pounding due to dead weight on the car axles, the same method is equally applicable in the case of electric motors and in fact has been adopted in the most advanced practice. Inasmuch as the cable roads run throughout the night at a considerable loss, any system which cannot compete with them is certainly in a hopeless condition. It is due to conservatism and to the general objection to the overhead system which exists in New York that the tentative introduction of the compressed-air motor has even been considered worthy of a trial, and it is in the continuation of these conditions that its only hope lies. If Mr. Hardie believes otherwise a conclusive demonstration might be made by attempting to introduce the compressed-air system on Brooklyn thoroughfares.—ED.]

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS.

DYNAMOS, MOTORS AND TRANSFORMERS.

Three-phase Motors with Low Speed. GOERGES. *Elek. Zeit.*, Aug. 13; a reprint with illustrations of a paper read at the recent meeting of the Union of German Electrical Engineers.—The ratio of the energy converted into heat in the wires to the total energy is equal to the ratio of the drop in speed to the total speed, from which it follows that it is very inefficient to run a three-phase motor at slower speeds; in the present paper he describes what appears to be a new and interesting phenomenon. The stationary part of a two-pole three-phase motor was connected as usual, but the revolving part contained only one short-circuited coil and is therefore magnetized by the currents in that coil, in only one definite direction; he calls this a winding with a single axis, as distinguished from the usual form in which there are two axes; with this machine it was noticed that it would run at two different speeds, namely, by full speed and half speed; if brought to synchronism it will act like an ordinary three-phase motor running at approximately synchronous speed; if loaded too much it falls suddenly down to half speed, at which it will continue as though this was the synchronous speed; if then unloaded completely it arrives at almost exactly half the speed of synchronism; if under these conditions it is driven by an outside power, so that its speed is increased somewhat, it will act as a generator delivering energy back to the circuit; at the half speed it generates a much larger torque than at full speed. A winding with three axes can readily be converted into one with one axis by opening one of the three circuits, when the remaining two will magnetize it in one direction. When such a motor was used for an elevator it acted as a brake when the elevator was descending. The explanation of this phenomena is not very simple; a curve showing the torque is given as determined from calculations; from this it appears that at every speed it can act as a motor or generator and it is only at half and full speed that the torque is exactly zero; for all other speeds it may be positive or negative. The heat generated by the current in this motor is according to calculations about one third of that when a winding with a three-phase axis is used, that is, with one axis it has a much better efficiency (apparently when compared with the other at this reduced speed); a 5-hp motor, whose normal efficiency was 80 per cent., had an efficiency of 40 per cent. at half speed and normal torque when the three brushes were used, but it had an efficiency of 60 per cent. when one of the brushes was raised; with three brushes the heat in the armature was 2083 watts and with two brushes 434 watts; the phase-shifting at half speed is very great. This phenomena is evidently only a special case of a much more general group of phenomena; he is convinced that an armature with windings having several axes can run at speeds depending on the number of axes, but these speeds will not be sufficiently stable for practice; a single-phase non-synchronous motor behaved in the same way and also acted as a brake at slightly more than half speed. He thinks this phenomena will be of great practical value; it has always been made use of in several installations, especially in connection with the pumps; it is especially applicable for railways; theoretically he considers it of very great interest.

Alternating-Current Machinery. Lond. *Elec. Eng.*, Aug. 21.—An interview with GOERGES, of the Siemens & Halske Company, of Berlin. In the annual output of generators and motors of this company about two fifths of the total power is represented by the polyphase system; the three-phase system is almost always used in preference to the two-phase on account of the advantages of the motors; the chief aim in the designing of three-phase generators is to have a small reaction in the armature; he favors synchronous motors as he thinks their use is warranted by the advantage of a power factor of unity and a saving of 10 to 15 per cent. in the current transmitted through the feeders; they construct a large number of single-phase motors which will start under full-load torque and take only 2.5 times the normal full-load current; if the current is kept down to its full-load value the starting torque is about half that at full load; their efficiency is not as high as that of the polyphase motor; the standard frequency throughout Germany is 50, although for transmission work only he prefers a lower one; a rise of frequency considerably increases the leakage drop of a transformer; the leakage through the iron is not the chief cause for the magnetic drop, it is due more to the induction in the space between the two coils where the magnetizing force is produced by the sum of the ampere-turns in the two coils; for higher frequencies the induction of the iron is lowered and the relative number of leakage lines increased; this is magnified in high-voltage transformers; he therefore prefers a frequency of 30 for transmission work only; for lower frequencies there is a greater output for a given weight because a larger induction can be used in the iron and there is also a saving of copper. A starting device which they use very much consists in providing the armature of three-phase motors with two circuits for each branch, having different resistances and number of turns; in starting they are connected so that their voltages oppose each other, leaving only the difference as the active voltage; when running normally "each circuit can act independently, and the effect is therefore increased nine times if the ratio of the turns in each of the parallel circuits is two to one." The method used in these works for measuring the power for three-phase motors is that devised by Froelich, which consists practically of three dynamometers, the thick wire coils of which are in series with the wires supplying the motors and the thin wire coils are connected through non-inductive resistances to a common terminal; it is a single instrument and gives the power independently of any variation in the three branches.

Continuous-Current Generator for a Three-Wire System. ROTHERT. Lond. *Engineering*, Aug. 21; an abstract of his Geneva Congress paper.—In order to enable a single machine to be used with a three-wire system DETTMAR has devised a new system, which differs from the other single-machine systems in that it enables the potential of the two branches to be kept constant; each pole is divided into two halves of equal size, the third brush being placed between these two similar poles; the armature has two windings; the third brush does not spark with this arrangement; the two leading poles feed one of the line wires, and the two following ones the other; the tension in the branches it is said will then not vary with the load, and they will work independently of one another; it is even possible to leave one branch unexcited; they are constructed in sizes up to 100 kilowatts. The *Elek. Zeit.* promises a detailed description.

Coupling Compound Machines in Parallel. *L'Ind. Elec.*, Aug. 10.—A note referring to the recent article of DUBSKY and GERAULT (see *Digest*, Aug. 29).—He claims that it is not the current passing through the equalizer to the series-winding, on which one should depend for rapid priming, as it is the shunt-winding which does this; the order of the connections should therefore be as follows: Close the shunt circuit, close the circuit of the equalizer, put the armature in circuit.

Energy Losses in Dynamos. ČORSEPIUS. *Elek. Zeit.*, Aug. 6.—A short, theoretical discussion, in which he expresses a disagreement with Blâthy in regard to the subject recently brought out by the latter.

Self-Induction in Alternating Armatures. BENISCHKE. *Elek. Zeit.*, Aug. 6.—A continuation of the discussion with Breslauer, which is herewith closed.

Graphical Representation of the Flux in Dynamos. Lond. *Elec. Rev.*, Aug. 21.—A translation of the article abstracted in the *Digest* last week.

Direct-Current Motor Operated with Rectified Alternating Current. HALL. *Canadian Engineer;* reprinted in the *West. Elec.*, Sept. 5.—An illustrated description of a system which was installed at Wentworth, O., three years ago, and is still running; the alternating current is reduced by means of two transformers whose secondaries are in series and are connected to a continuous-current motor through a commutator driven by a synchronous motor; the commutator has eight segments and the brushes are of carbon; it appears that there is a small spark; with mica between the segments both the brushes and the commutator were burned, but without the mica the brushes alone were disintegrated; the continuous-current motor had an output of five kilowatts; the synchronous motor required 150 watts; the efficiency of the combination was found by measurement to be 81 per cent. As alternating-current motors either of the single or multiphase type have a lower power factor and are expensive to construct he thinks that some modification of the present method would be preferable.

Construction of Commutators. TURNER. *Amer. Mach.*, Sept. 3.—The beginning of an article on this subject, the first portion of which is devoted to the construction of small commutators; it is of a practical nature.

LIGHTS AND LIGHTING.

The Temperature of the Carbon in the Arc. C. E. G. *La Nature*, Aug. 1.—A short note offering an explanation of the apparent or real diminution of the brightness of the positive carbon while the pressure is increased, as noticed by Wilson and Gray. Villard found that the solubility of iodine, bromine and other materials in the surrounding gas increases rapidly with the pressure; the present writer suggested that the same may be true of carbon in an atmosphere of nitrogen; the carbon would then dissolve with energy which is greater as the density of the medium becomes greater; the temperature at which this dissolution

takes place normally would then be lowered by a corresponding quantity which would explain why the brightness of the carbon diminishes as the pressure increases.

Jandus Arc Lamp. KOERTING AND MATHIESEN. *Elek. Zeit.*, Aug. 6.—A reply to the statements of Toerring (see *Digest*, Aug. 22). Their tests were made with a dry atmosphere and with dry carbons; any moisture in the inner globe would soon be expelled; they think that the mantle of flame cannot exist to an appreciable degree, as the consumption of the carbons is very small; they claim that a wandering of the arc must of necessity exist as the carbons are burned off smoothly and the positive carbon shows no crater, which is a proof that the arc is continually wandering about; they claim that the globes were cleaned; they claim that the extended use of such lamps in America is no criterion, as solid carbons are still used there and the requirements made of lamps are not nearly as severe as in Germany; the cost of carbons and of attendants is also much greater in America.

Projecting Lamp. MARESCHAL. *La Nature*, Aug. 1.—An illustrated description of a new form of lamp which has given good results and the cost of which is not great.

POWER AND HEAT.

High-Tension Continuous-Current Distribution. THURY. Lond. *Engineering*, Aug. 21. *Elec. Zeit.*, Aug. 20; a brief abstract of his Geneva Congress paper, including descriptions of several of his installations which will be described more fully in London *Engineering*.—The Biberist line has a length of 15 miles; in Brescia 700 horse-power are transmitted over 12 miles at a maximum of 15,000 volts; he claims that his lines are easily calculated, his switchboards simple; that the motors are easily started and regulated; that the consumers cannot use more current than they are entitled to; that the lightning trouble which is so serious in parts of Switzerland has been successfully overcome and that high tension involves no danger. For over 1200 volts (constant-potential distribution) motors cannot be constructed for less than six horse-power; in the series system with constant current there is no such lower limit to the size of the motor; the upper limit of the voltage is determined only by the loss but not by the generators or motors, and it is therefore so high that the system is well adapted for long distances; at present generators for 45 amperes can be constructed up to 3000 volts and he thinks 4000 could also be successfully used; he does not consider the system dangerous; the machines and the attendants are carefully insulated; the generators are driven either by belts or by Raffard couplings, and in either case are sufficiently insulated thereby. In the discussion comparisons were made with this and the three-phase system introducing the usual arguments. Kolben stated that the effects of the troubles of the wattless currents can be reduced to a minimum by proper construction; the motors should be carefully constructed with a small air space and with low no-load current; transformers should have small drops, the wires should not be greater than 7.5 mm in diameter to diminish the self-induction; generators must have strong fields, the loss of voltage for lamps being at most 4 to 5 per cent., and for motors with a power factor of 0.8, 15 per cent; such transformers and alternators will be somewhat larger, but the increased cost is not appreciable in the total cost of an installation; the total efficiency of a continuous-current system might in special cases be 1 to 1.5 per cent. greater, owing to the absence of the transformers, but he thinks this is more than balanced by the increased complications; the adaptability of alternating motors for series work has often been doubted, but in Vienna many such motors are in use up to 4 horse-power for elevators. Thury, in his reply, stated that he would not materially alter his plant at Genoa if he had to rebuild it; transformers were dangerous and alternating sparks passed more easily than continuous ones with the same voltage; polyphase motors do not operate satisfactorily in sugar works, where they are being replaced by continuous-current motors.

Long-Distance Power Transmission. BRADLEY. Lond. *Engineering*, Aug. 21; a very brief abstract of his Geneva Congress paper.—He advocates single-phase transmission down to the transformers; he referred to the difficulties caused in alternating circuits by the inter-connection between inductance and capacity; he would balance each capacity and each inductance locally and divide a line say into three-mile sections; each could be compensated at a slight expenditure of energy, while the regulation would be greatly facilitated. The second part of his paper concerns his phasing transformers.

Ship Cranes. Elek. Zeit, Aug. 20.—A brief, illustrated description of one made in Germany.

Big Cottonwood Power Transmission Plant. Elec. Eng., Sept. 2.—A description of this plant accompanied by a number of illustrations and views; it is in successful operation for distributing power throughout the valley around Salt Lake City from the Wahsatch Mountains. The available fall is 1000 feet, but at present only about 400 are used; the power is transmitted 14 miles to Salt Lake City, the minimum water-power is 2447 horse-power; by means of a storage reservoir a net power of 40,000 hp-hours can be obtained daily; the line consists of four circuits of three wires each, of No. 2 soft-drawn bare copper; the line voltage is 10,000 and the loss 5 per cent.; an electric light company at the distant end buys all the current at wholesale, by the metre; for anything above 10 horse-power for motors the power is sold directly to the consumers; the cost of the plant is estimated to be $132.72 per net horse-power delivered in the city ready for use; the earnings per annum are estimated at $200,000.

Gas Versus Electricity Direct from Coal. DUNNING. *Eng. Mag.*, September.—He endeavors to show that with modern gas works handled in a proper manner an efficiency can be obtained, "which is about all that could be produced even should science succeed in the production of electricity direct from coal"; he describes the modern gas works, showing how the cost can be reduced, and points out the importance of the bi-products, stating that the dividends of to-day are declared from the wastes of yesterday; he refers with very favorable comments to Jacques' battery, in which the inventor claims to generate electricity direct from the energy of the carbon; the article is of a general character and contains but few disconnected figures.

Iron Smelting in Sweden. Eng. & Min. Jour., Aug. 29.—A note stating that a concession has been obtained from the Swedish Government for the establishment of a company for the smelting of ores in electrical furnaces on a large scale, the power being derived from a waterfall; the Laval process is to be used.

TRACTION.

Disturbances in Telephone Lines. WIETLISBACH. *Elek. Zeit.*, Aug. 20; an abstract of a Geneva Congress paper (see *Digest*, Sept. 5.)—The conclusions adopted by the Congress, which are given in full, are briefly as follows: Telephone lines can be protected sufficiently well against strong currents by abandoning earth returns and using metallic circuits; the strong-current circuits should be so insulated and so placed with regard to telephone circuits, that the currents passing to earth and the induction effects are reduced to a sufficiently small amount; for earthed circuits, like those for railways, the outgoing line and the apparatus connected with it should be well insulated; there should be insulated return wires, and, if necessary, boosters in those circuits; the rails should be well bonded, transversely connected and have special return feeders; the motors should be so constructed as to produce as little undulation of the current as possible; at overhead crossings the telephone lines should be protected with fuses when the voltage does not exceed 750; with a higher voltage the strong-current wires should be protected with guard wires which are well earthed, and have their earth connections tested continually.

Elevated and Underground Railways in Large Cities. BRAUN. *Elek. Zeit.*, Aug. 6.—A reprint of a paper with the illustrations, read at the recent annual meeting of the Union of German Electrical Engineers. After showing briefly the great advantages on such lines of electric traction over steam and cable, he gives brief, illustrated descriptions of all the existing lines and those under construction, namely, the following deep tunnel lines: City & South London, Waterloo & City, Central London; the following elevated lines: Liverpool, Chicago; the following running under the surface of the streets: Budapest, Boston; and finally the Berlin line which is under construction; the illustrations are confined to the civil engineering features.

Traction Diagrams. TOMLINSON. Lond. *Elec. Rev.*, Aug. 21.—He continues the discussion begun in the previous installment (see *Digest*, Aug. 29) and begins a consideration of the plotting of the actual power required from point to point on a given line.

Glasgow Railway Report. Lond. *Elec. Rev.*, Aug. 21.—Some comments on the report of the committee on its tour of inspection of Continental roads on which mechanical traction is used; conduit devices are treated quite exhaustively in the original report.

Speed, Power and Efficiency of Electric Motors for Locomotives. BARNES. *West. Elec.*, Aug. 29; a reprint of a paper read before the Western Railway Club.—It contains a number of curves showing the relations between these quantities; it is of an elementary nature.

Electric Mine Locomotive. Elec. Eng., Sept. 2.—A reproduction of the illustrations of the 200-hp mining locomotive mentioned in the *Digest*, July 11.

Behr's High-Speed Railway. Elec. Eng., Sept. 2.—A reproduction of a cross-section of the car; the system was described in the *Digest*, Aug. 15.

Boston Electric Subway. Sc. Amer., Sept. 5.—A brief description with a number of illustration of this subway.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Protection of Overhead Lines Against Lightning. CHAVANNES. Lond. *Engineering*, Aug. 21; *Elek. Zeit.*, Aug. 20; an abstract of his Geneva Congress paper.—He referred to the great danger from this cause in Switzerland; the position of the wire on the pole seems to have no influence, as it is sometimes the upper and sometimes the lower or middle one that is struck; there is generally some faulty spot; condensers and coils have answered in many cases, but not always; for continuous currents he prefers connecting the poles through water to earth, but the protection of alternating-current lines was more difficult; the paths to

earth should have as little self-induction and resistance as possible; they should be straight and each should have a separate earth; continuous current machines may be protected with choking coils, but alternating circuits should have a number of lightning arresters along the line; fuses should not be used and automatic circuit-openers are absolutely necessary; sufficient protection can be obtained for alternating-current systems when all the poles are connected permanently to earth through water resistances, but it involves a loss of current; no information was given on the use of condensers for such protection; most of the arresters are effective if properly applied; in no place should such circuits approach others closer than 12 to 15 inches; on underground circuits both poles should be protected. In the discussion Thury stated that up to 500 volts the insulation of the frame of the machine is not necessary, but for higher voltages it must be very good; a modification of the Wood arrester was found very satisfactory; Georges described the arrester which was noticed in the *Digest* last week; for modern voltages the Wurtz non-arcing arrester is quite reliable; Hillairet considered the direct lightning effects on lines as not dangerous to persons, but those induced in the circuit are; in mountainous regions every pole should have an arrester; in North Africa he found that the arresters operated even when the sky was clear; he advocates insulating the machines; the best material for arresters is zinc. At Brescia, where the line is exposed to terrific storms, an arrester resembling the American pattern gave complete satisfaction; in one of them the discharge passes from one set of carbon points to another, which points are separated from each other by the action of the current, thereby extinguishing the arc. The Congress endorsed the request for further statistical material regarding the subject.

Protecting Lighting and Power Circuits Against Lightning. Goerges. *Elek. Zeit.*; Aug. 6.—A reprint in full of a paper read before the Electrical Society in January in reply to the request for statistical material. It is limited almost entirely to a discussion of the principles of lightning arrester, and includes illustrated descriptions of some of them, most of which are of American origin; it appears to contain nothing new; it is followed by a reprint of the discussion.

Cost of Electricity Supply. Wright. Lond. *Elec.*, Aug. 21.—A reprint in full of his Municipal Electrical Association paper, which was abstracted in the *Digest*, July 4; it is followed by the discussion.

Electric Lighting in Australia. Spencer. Lond. *Elec.*, Aug. 21.—An article pointing out how far behind that country is in electric lighting, and giving brief descriptions of existing installations.

Central Station at Kaiserslautern. Laffargue. *L'Ind. Elec.*, Aug. 10.—A brief description of this installation, with figures showing the operation for the first year.

Hanover. Elek. Zeit., Aug. 6.—A long abstract of a report on the operation of this station for the year ending March, 1895.

Changing the Frequency. Gutmann's method. *Elec. Eng.*, Sept. 2.—A brief, illustrated description of a device for changing the frequency at the place of consumption; an armature wound like a Gramme ring has connections to three symmetrical points and revolves in a bi-polar field excited by the alternating current; the alternating current generated in any one of the three coils will then have a frequency differing from that of the current exciting the field.

Electric Plant at the Duquesne Steel Works. Elec. Eng., Sept. 2.—An illustrated description of this plant, at Cochran, Pa., in the works of the Carnegie Steel Co.; it supplies light and power to the steel mills, six furnaces and various yards and buildings.

Edison Station in Brooklyn. Barstow. *Cassier's Mag.*, September.—A short article on "Local Developments of an Electric Central Station," in which he gives a brief history of the Edison station in Brooklyn, showing how it kept up with local developments.

WIRES, WIRING AND CONDUITS.

High-Pressure Concentric Cables and Their Accessories. Hetherington. *Cassier's Mag.*, September.—A long, profusely illustrated article, giving the results of his long experience with such cables in England, and describing, with the aid of illustrations, a number of different joints, junction boxes, street switches, etc., as used in England. Concentric cables, lead-covered and generally armored, are increasing in favor in England; he had the supervision of the first concentric cable laid in London in 1890, when he laid nearly 15 miles of three different makes; in this there has not been a single electrical failure up to the present time, although worked at 2400 volts, with hundreds of service lines from it; in another case of nearly 25 miles, with joints at every 20 feet, working at 10,000 volts, only a few of the joints failed. The article is mainly descriptive and gives the results of his extended experience. Among other things he believes that armor made of two steel ribbons, with a cushion of tarred jute between it and the lead, is quite as safe as the more costly pipes and conduits; high insulation resistance means neither durability nor resistance to disruptive discharge.

ELECTRO-PHYSICS AND MAGNETISM.

Magnetic Researches at the Reichsanstalt. Ebeling. *Elek. Zeit.*, Aug. 20; a reprint of a paper read at the recent meeting of the Union of German Electrical Engineers.—He gives briefly the results of recent work done in this direction at that laboratory. The object was to perfect the methods of making magnetic measurements; the second part of the paper gives the results of some of the measurements. Most of the usual magnetic measurements are relative and give only approximate values; for absolute determinations there are only two methods, the magnetometric and the ballistic, in both of which the preparations of the samples involve difficulties, or at least a large amount of time; as to the accuracy of the ballistic method there is no definite knowledge; a careful comparison of the various methods is therefore necessary; for the present the yoke method is used at that laboratory, as the samples are of a convenient form; it also involves some of the objections of the ballistic method; it is, however, sufficient for technical purposes which was shown by a comparison with the magnetometric method by making an ellipsoid and a rod of the same iron and examining each by one of the methods, when practically the same curves were obtained; the method was studied more carefully and compared with the others by making rings, ellipsoids and rods of the same iron; unfavorable results, however, were obtained owing to the differences in the samples; even with excellent Swedish wrought iron very bad pieces were found; a large number of rods were therefore tested through short distances of their length by moving them through the apparatus and obtaining the curve for different parts; it was then found that approximately the electric conductivity was proportional to the magnetic qualities; out of 40 samples about one third were more or less bad, while all were somewhat irregular; there was only one which was uniform, and this was a piece of cast steel; experiments were tried to make the samples uniform by annealing, for which purpose they were put into a furnace for manufacturing porcelain, which was very well adapted for the purpose and had an extremely uniform temperature; the results were that a wrought iron rod which was magnetically heterogeneous was scarcely affected by two such annealings, although it had become much softer; a heterogenous rod of steel was appreciably improved. The general results of the researches were as follows: the best material for exact magnetic determinations is a carefully cast metal; wrought iron is of no use; good cast steel, however, is at present practically as good as the best Swedish iron; with the best possible material it is now possible to make absolute determinations on the accuracy of the results of which one cannot depend; all absolute determinations in that laboratory will in the immediate future be made with ellipsoids. He then refers to the determination of the ballistic reduction factor of the galvanometer by means of which the deflections are reduced to absolute values; this is done by taking a solenoid whose dimensions and constants can be calculated and to start, stop or commutate a current through it, sending the current induced thereby in a second concentric coil, through the galvanometer; the construction of such a coil is difficult; he describes one made of marble and one of hard rubber; such coils are useful as standards for other purposes also, as for instance determining the dimensions of other coils by comparison. The last part of the paper gives a few of the results of measurements of characteristic magnetic materials; these are given in the form of a short table which gives the coercive force, maximum permeability, magnetizing field and the hysteresis loss for these different materials, in absolute units; the values for two samples of steel which were remarkably good and thought to be the best yet obtained are as follows: The limiting values of the coercive force were 74 and 65, the remnant induction 9720 and 11,450 and the hysteresis loss 248,000 and 243,000.

Annealing and Magnetic Heterogeneity. Ebeling and Schmidt. *Elek. Zeit.*, Aug. 20; abstracted from the *Zeit. f. Instrumentenkunde*, Vol. 16, page 77.—A detailed description of the results briefly referred to in the abstract above by one of the authors, describing researches made at the Reichsanstalt. A large number of samples were carefully annealed and tested for homogeneity before and after; the results are as follows: Annealing the iron, if done very evenly, can sometimes be beneficial if homogeneous material is desired; unequal heating makes the material worse; materials cannot all be made homogeneous by annealing; whether the magnetic qualities correspond with the chemical composition was not determined; the most homogeneous material is that which is carefully cast.

Magnetic Homogeneity and Electric Conductivity. Ebeling. *Elek. Zeit.*, Aug. 20; abstracted from *Zeit. f. Instrumentenkunde*, Vol. 16, page 87; a description of the work at the Reichsanstalt briefly referred to above in the article by that author.—He endeavored to find whether the magnetic heterogeneity can be determined by the electric conductivity; a constant current of one ampere was sent through the samples and the loss in voltage measured at fixed intervals along the bar; he found that those samples which have small differences in their magnetic qualities also have small differences in their electric conductivity; the converse that homogeneous magnetic materials have an even conductivity has exceptions, which are thought to be due to mechanical faults in the material.

Wattless Currents. Blondel. Lond. *Engineering*, Aug. 21; *Elek. Zeit.*, Aug. 20; an abstract of his Geneva Congress paper.—It treats quite fully with the fairly well understood problems of idle currents for which Dobrowolsky introduced the name "wattless" currents; it appears to be a good summary of the subject, but seems to contain nothing new; he does justice to all the attempts to deal with these currents and comes to the conclusion that we need further research on good industrial condensers and polarizers, on induction motors excited by currents apart

from those of the distributing circuit and on alternators whose armature-reactions can "instantaneously be compounded" and whose mass is more fully utilized. The discussion was mainly confined to the term "wattless currents"; Mascart protested against this and suggested quadrature currents; Palaz and Hospitalier thought the former term could not be dispensed with; the English were satisfied with the term idle currents. Mengarini stated that in the transmission plant from Tivoli to Rome condensers of two microfarads have been in use for several months to diminish the phase-shifting and have been very satisfactory; they are cheap, require no attention and have a hysteresis loss of only 1 per cent.; their construction is at present kept secret. Kolben stated that Blondel taught us how to cure by artificial means what no longer caused serious trouble with experienced constructors.

Magnetic Observations in Switzerland. *Elek. Zeit.*, Aug. 6.—A brief abstract of a recent report on observations made by Van Rijckevorsel and Van Bemmelen.

Alternate-Current Rushes in Condensers. BERRY. Lond. *Elec. Rev.*, Aug. 21.—A short communication describing briefly a series of experiments made some time ago. A condenser was placed in series with a short open coil and a switch; one of the wires attached to the condenser had short silk threads attached to it; on making and breaking the circuit very quickly these threads behaved in a very erratic manner, trying to stand perpendicularly to the conductor, after which they became limp again; when the circuit was made and broken more slowly so as to cause an arc, the fibres would stand out from the conductor as though electrified by a much higher voltage than the applied pressure, which was 2500, and which was itself unable to cause the fibres to even move; when the circuit was made and broken quickly a spark would sometimes pass between one end of the coil and a brass plate on which it was resting, although insulated therefrom, the plate being in contact with the other end of the coil; when the current was broken slowly this spark became much more frequent. These sparks showed that there existed a very high-frequency current and the behavior of the fibres was a proof that a very high voltage often existed between the mains after breaking the circuit.

Operating Induction Coils from Lighting Circuits. LEBEDEW. *Elek. Zeit.*, Aug. 20; abstracted from the *Wied. Ann.*, Vol. 58, page 408.—He describes satisfactory experiments made by inserting a resistance between the mains of a lighting circuit and shunting a current from a part of this resistance, through the induction coil, tuning fork or other device which is intended to be operated; by properly determining the relation of the shunted resistance to the other there is no fear of a destructive spark.

Influence of Cold on the Conductivity of Metals and on Cathode Rays. PICTET. Lond. *Engineering*, Aug. 21; a very brief abstract of his Geneva Congress paper; the report says the paper was disappointing.—The laws of Hirn do not necessarily apply to electricity; the electric current is the passing of a certain quantity of ether around the molecules like a water current passing around small islands; at very low temperature the entire molecular spaces and therefore the energy are reduced. When cathode rays are produced in a bulb, the bulb will shine beautifully when cooled.

Effect of Light on the Resistance of Selenium. MAIORANA. *Nuovo Cimento*; noticed in the Lond. *Elec.*, Aug. 21.—He finds that the effect is anything but instantaneous; with a normal resistance of 258,100 ohms it was 224,000 after the first second of illumination, and 212,000 after the second, gradually approaching a limit of about 200,000; the recovery proceeded equally gradually.

Röntgen Rays in Surgery. Lond. *Lancet*; abstracted briefly in the Lond. *Elec. Eng.*, Aug. 21.—In an article by LEWKOWITSCH he describes a new method for the application of the rays for detecting the presence of foreign bodies in the eye, and determining their position; the impression is taken on a special form of plate, which is capable of being inserted into the orbital cavity, between the walls of that cavity and the eyeball. In an article by MACINTYRE he states that he found that for the deep seated structures of the body greater currents through the tube are required; he obtained photographs of the spine and omitted the heart and sternum, and, on the other hand, the latter could be photographed with the spine omitted; the heart, diaphragm, liver, etc., could all be seen.

Regular or Specular Reflection of Röntgen Rays from Polished Metallic Surfaces. ROOD. *Amer. Jour. of Sc.*, September.—An article of some length describing a series of experiments. Among his results he finds that platinum foil at an angle of 45 degrees reflects one 260th part of the incident rays; a speculum mirror reflected a portion of diffused rays; platinum reflected somewhat more than speculum metal; it appeared that X-rays reflected from flat polished metallic surfaces, consisted of regularly reflected rays mixed with others that have undergone diffuse reflection; "polished metallic surfaces do not furnish a mixture of regularly reflected and of equally diffused X-rays"; they appear according to his observations to furnish, at an angle of 45 degrees, a certain amount of regularly reflected rays, together with a quantity of rays that are not equally scattered in all directions, but that stray from the others only to a moderate extent; metallic surfaces which are highly polished for ordinary light are only imperfectly polished for X-rays; his experiments conform with the idea that the X-rays consist of transverse waves differing from those of light only in being much shorter.

Wave-Lengths of Röntgen Rays. *Nature;* reprinted in the *Elec. Eng.*, Sept. 2.—FOMM, of Munich, in the *Sitzb. der Bayerischen Academie*, 26, 2, describes a successful measurement based on the diffraction through a narrow slit in a brass plate; the wave-length was determined by means of Lommel's formula and was found to be 0.000014 mm, which is about 15 times smaller than the smallest wave-length hitherto observed in the ultra-violet; this is thought to give the upper limit rather than the exact measurement of the wave-length. SAGNAC used a wire grating and obtained the value 0.00004 as an upper limit. The question arises whether Röntgen rays consist, like ordinary light, of radiations whose wave-lengths vary over a considerable range. Some experiments by DWELSHAUVERS-DERY are briefly described; he endeavored to find whether certain substances are more transparent for certain Röntgen rays than for others; he measured their transparency with respect to tin; he found that the transparency of every specimen, with the exception of obsidian, increases during the first few minutes; agate and alum after increasing for some time become more and more opaque; obsidian continually diminishes in transparency; the absolute transparencies of different substances vary according to the state of the tube, which may be explained by the actinochroism of Röntgen rays.

Regulating the Vacuum in X-Ray Tubes. MCNEILL. *Sc. Amer.*, Aug. 21.—A short communication stating that as the increase of vacuum was due to the absorption of gases by the platinum anode, and as the negative pole threw off gas, he reversed the polarity of the tube when the vacuum got too high, instead of heating the tube with a flame, which is apt to crack it; he has used this method for the past two months with perfect success; after an hour's run with a tube he reverses it, after which it is again ready for another hour's run; the coil should be cut down in power when reversed, as there is danger of disintegrating the platinum; he cuts out half the battery power while reversing.

X-Ray Laboratory in Chicago for Medical Diagnosis. *West. Elec.*, Aug. 29.—A brief description of this laboratory, with an illustration showing an interior view of the same; a number of photographs of bones of the human body are also reproduced.

Aurora, Solar Corona and Comets. LEVISON. *Sc. Amer.*, Sept. 5.—An abstract, with some of the illustrations, of a paper read before the New York Academy of Sciences, on a comparison of low and high vacuum electrical and radiant matter phenomena with the aurora, solar corona and comets.

Notation of Terrestrial Magnetic Quantities. BAUER. *Science*, Aug. 28.—A short communication in which he recommends using the first letter of the word designating the particular quantity; thus D for declination, I for inclination, H for horizontal component, V for the vertical component and F for the total force; in this he differs from the notation to be proposed at the International Meteorological Congress in Paris.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolysis of Sulphuric Acid. ASKENASYS. Lond. *Elec.*, Aug. 21.—A brief editorial reference to his recent German patent referring to the electrolysis of concentrated sulphuric acid; the chief products are ozone, sulphur and sulphuretted hydrogen; the first oxidizes any dissolved organic impurities and decomposes chlorides (both of which may be done by boiling the acid); the other two products reduce the oxides of nitrogen and precipitate metallic impurities as sulphides; six volts are used, with a current density of one or two amperes per square decimetre, the electrodes deing of lead and the liquid being agitated after a short interval. The process is criticised unfavorably, as it is thought to do imperfectly and at a great cost what is already done perfectly and cheaply by well-known means.

Dry Cell. SCHMIDT. *Electrochem. Zeit.*, August.—A brief description of an improved form in which the retaining cell is made of a cylinder of zinc, in which is placed a hollow cylinder of carbon closed at the top and containing another cylinder of zinc in the inside; the space around the outside of the carbon is filled with the usual plastic material, while that in the inside is filled with the active liquid; as the liquid contained in the paste is consumed, fresh liquid from the interior portion of the carbon will percolate through the pores of the carbon to the paste; the inside and outside cylinders of zinc are connected with each other.

The Flow of Currents Through Liquids. BUCHERER. *Electrochem. Zeit.*, August.—The first installment of an article in which he endeavors to explain the way in which a current flows through a liquid in accordance with his theory of electrolysis, which differs from that of Nernst; he discusses metallic conductivity, thermo-electricity and the flow of the current through an electrolyte; according to his theory the metals are vaporized at the anode and condensed at the cathode.

Electrolytic Purification of Sewage. HARGREAVES. *Electrochem. Zeit.*, Aug. 1.—An article of a general character pointing out the advantages of chlorine in the destruction of the poisonous organic matter in sewage; he discusses the electrolytic process, giving some theoretical figures regarding the cost.

Uses of Electricity in Metallurgy. BORCHERS. Lond. *Elec. Rev.*, Aug. 21.—An abstract with the diagram of the article noticed in the *Digest*, Jan. 4.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Calibration of Alternating-Current Measuring Instruments. WILKENS. *Elek. Zeit.*, Aug. 6.—A brief description of the methods used by the Gen-

eral Electric Company, of Berlin, for calibrating certain commercial alternating-current measuring instruments, more particularly the phasemeter for three-phase currents. For this purpose a phase regulator is used, an illustrated description of which is given; with it the phase of the voltage current, as compared with that of the main current, is made any desired amount; it consists of a ring transformer constructed like a gram ring with a commutator; three-phase currents are passed through it at three equally distant points; to reduce the magnetizing current a laminated iron ring is also placed in the circular space in the interior of the other ring; two insulated brushes make contact with the commutator at two diametrically opposite points; according to the position at which these are placed, the current taken from them can be made to have any desired phase, as compared with any one of the other three-phase currents; the complete connections for calibrating the phasemeter are given. The three-phase wattmeters are calibrated in a similar way; they differ from the phasemeter only in the connections. To apply the principle of the phasemeter to the wattmeter for single-phase currents, the voltage current must be shifted artificially through 90 degrees; this can be accomplished only approximately by a choking coil; to make up the difference an inductionless resistance is connected in parallel with the voltmeter; the theory of this is given. He thus shows that with the aid of very simple means it is easy to apply the principle of the phasemeter to a wattmeter for single-phase currents.

The Capillary Electrometer in Theory and Practice. Burch. Lond. *Elec.*, Aug. 21; the conclusion of his series of articles (see *Digest*, Aug. 8).—In his conclusion he recommends this instrument as the cheapest form of electrometer that can be made; when it has received the attention it deserves he thinks it will become as familiar an instrument as the thermometer; the construction is so simple that a new one can be made in less than an hour; it is essentially the instrument to be used by those whose means are limited.

Standard Self-Induction Coils. Wien. *Elek. Zeit.*, Aug. 20; abstracted from *Wied. Ann.*, Vol. 58, page 553.—The form is that of Maxwell, giving the maximum self-induction; the coils are wound on surpentine, as this does not change its shape; from results of calculations and tests he finds that he can guarantee them to an accuracy of at least 1 in 1000; tests show that their value is practically independent of time and temperature.

Photometric Units. Elek. Zeit., Aug. 20; an abstract of the resolutions of the Geneva Congress (see *Digest*, Sept. 5).—The Congress recommends that the twentieth part of the violle is a theoretically correct unit, but as it cannot be reproduced practically, the Hefner lamp is accepted as the unit for industrial purposes.

Application of the Secohmeter. Heinke. *Elek. Zeit.*, Aug. 6.—The conclusion of the article noticed in the *Digest*, Aug. 22.

Determining the Form of Alternating-Current Curves. Gasnier. *L'Ind. Elec.*, Aug. 10.—A brief summary of the principal methods which have been proposed.

Copper-Depositing Process. Dumoulin. *Eng. & Min. Jour.*, Aug. 29.—A brief mention of a process which is being tried in England for depositing copper electrolytically in the form of sheets and tubes direct from the matte or precipitate. The essence of the invention is in the method of making the deposit homogeneous; in the well-known Elmore process this was sought to be done by a continual polishing with agate, but it was not a success; in the present process a body impregnated with a greasy matter is so placed that if any irregularities occur in the deposition of the metal, the projecting portions touch the greasy body and thereby become covered with grease, thus confining the deposition to the hollow portions; when the surface becomes level again the grease is automatically rubbed off; so little pressure is put on the surface that lamination does not occur. A test for strength showed a breaking stress of 45,000 to 52,000 pounds per square inch, with an elongation of 10 to 21 per cent., which are very high figures; the specific gravity is 8.94 and the resistance 1580 to 1590.

Process of Electrolytic De-Silvering of Argentiferous Lead. Tommasi. *Eng. & Min. Jour.*, Aug. 29.—A translation in abstract of the French Academy paper, abstracted in the *Digest*, Aug. 8.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Double Microphone Batteries. Elek. Zeit., Aug. 13; an illustrated description of the Wurtz system.—When a microphone is used frequently without sufficient intervals to allow the battery to recuperate, its E. M. F. falls very greatly; this is especially the case with dry cells; to overcome this two sets of batteries are used in the present system, and by means of a small ratchet arrangement connected with the lever on which the telephone is hung, each of these two batteries is used alternatively, thus giving each one a rest while the other is in use; a diagram showing the switching arrangement is given.

Telephone System at Stockholm. Johansson. *Elek. Zeit.*, Aug. 6; an illustrated description of this system.—The ideal system in a large city is to have all the subscribers connected with one station, that is, to have no interconnections between stations, but as no satisfactory system of this kind has yet been devised, the best system is the one which approaches the ideal as closely as possible; the present system is one of this kind and has been in use since November, 1894; there are three large stations.

Cable Ship "Tutanekai." Lond. *Elec. Rev.* and *Elec. Eng.*, Aug. 21.—A brief, illustrated description of this vessel, which was built for the New Zealand Government chiefly for repairing the Government cables.

Signal Controllers. Prasch system. *Elek. Zeit.*, Aug. 20.—A brief, illustrated description of this system, for which the German Railroad Union gave a prize. The apparatus is for operating signals at distant points.

MISCELLANEOUS.

Production of Diamonds. Moissan. *L'Ind. Elec.*, Aug. 10; *L'Eclairage Elec.*, Aug. 15.—An abstract of an Academy paper describing some new researches; in these he endeavored to reduce the amount of iron fused and to cool it more rapidly; a fused globule of iron saturated with carbon was dropped from the electric furnace into a bath of mercury; the metal was afterwards dissolved with acids, leaving a residue of diamonds, some of which were black and others transparent; the latter were very small crystals, but remarkably regular. Several other modifications of the method were tried with more or less success; in one case additional pressure was brought on the cooling metal, with which better results were obtained.

Electrical Apparatus. Tischendoerfer. *Elek. Zeit.*, Aug. 13.—The first of a series of articles on the exhibition in Nuremberg; the present portion is quite long and gives illustrated descriptions of the machinery made by the Schuckert Company, including dynamos, portable lighting plants, search lights and various other electrical apparatus.

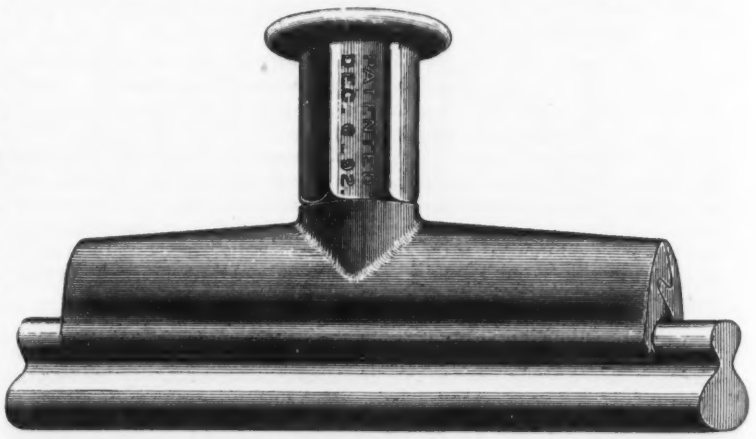
International Electrical Congress in Geneva. Elek. Zeit., Aug. 20; Lond. *Engineering*, Aug. 21 (continued).—A running account of the proceedings, with brief abstracts of the papers, which are noticed under their respective headings in these columns.

Electrical Industries in Berlin. Elek. Zeit., Aug. 13.—An extract from a recent report on the industries of Berlin for the year 1895, giving the state of the electrical industries in that city.

Educational. Maycock. Lond. *Elec. Rev.*, Aug. 21.—A brief, unfavorable criticism of some of the questions in a recent Science and Art examination.

The Improved Hercules Clip.

The use of the special wires shaped like the figure 8 and clover leaf, such as is used on the Nantasket Beach road, and for high-speed service on suburban lines, has led to the devising of several forms of clips for attaching the wire to the insulated hangers. A mechanical clip suitable for use with this kind of wire is the "Hercules." As shown in the illustrations, this clip consists of two castings forming the jaws, which are automatically locked together by a nut, which also forms the part for attaching the clamp to the hanger. The tongue and groove are features which are not found in similar devices. When the two castings are placed upon the wire they automatically lock themselves and the wire in place as the nut is screwed home. The tongue and groove preserve the rigidity of the device throughout its length, so that the weak points at the ends of several mechanical clips are practically obviated in



Trolley Wire Clip.

the "Hercules" design. We are informed that tests conducted by some disinterested parties have shown that the holding power of the "Hercules" clip is almost twice as great as that of ordinary soldered ears, while the advantages the mechanical clip offers in the way of convenience, rapidity of application, cheapness, durability and smooth running, offset the inconvenience and much greater cost of the soldered. The clamp may be readily loosened so as to permit adjustment of the line. The "Hercules" clip, as furnished by the H. W. Johns Manufacturing Company, has been improved in some of its details, which warrants the company in anticipating ready sales.

Data on Tests of a 300-HP De Laval Steam Turbine.

Not a little interest has been taken within the past few years in the performance of steam turbines for the driving of dynamo-electric machinery. The results of tests made on a 300-hp steam turbine, one of two supplied to the Edison Electric Illuminating Company, of New York City, by the Maison Breguet, of Paris, representing the Société De Laval, have lately been furnished us by the Edison Company. The tests were carried out by Mr. J. Van Vleck, constructing engineer for the Edison Company, and M. Paré for the Société De Laval. The tests refer to the turbine installed in the Twelfth Street station, and give the complete operating data under conditions of full load and a *resumé* of some tests under ordinary load. The brake horse-power was obtained from the effective horse-power by assuming that the commercial efficiency of the 100-kw dynamos was 90 per cent., there being two Desroziers connected by means of gearing to one turbine and located on each side of the turbine shaft. The turbine disc has a diameter of ¾ of a metre (29.5 inches) and a thickness through the blades of about 10 millimetres (.4 of an inch). The disc runs at 9000 revolutions per minute and the dynamos at 750 revolutions per minute. The total equipment, comprising steam turbine, gearing and dynamos occupies a space of 4.05 metres (159 inches) long, 1.97 metres (77⅜ inches) wide, and 1.31 metres (51 inches) high. When operating condensing at a steam pressure of 145 pounds to the square inch and a vacuum of 26 inches, the steam consumption was not to be over 18.7 pounds per brake hp-hour. The type of unit tested is shown in the accompanying illustration. The exhaust is located at the extreme right and the turbine disc directly below the steam feed-pipe. The oval casing in the centre of the picture contains the gearing, the turbine shaft being in the centre and on either side of it the generator shafts directly connected to the Desroziers machines, one of which is in the foreground and the other directly behind it.

Two observers took readings throughout the tests on the same machines for the purpose of averaging the results. The duration of the tests extended over a period of six hours, during which time the voltage of the machine on the positive side varied from 126 to 128.5 volts, while the current varied from 676 to 743 amperes. On the negative side the voltage varied from 126 to 130 and the current from 691 to 760. The inlet condensing water during the test varied in temperature from 77 to 84 degrees Fahr.; the discharge water from 100 to 108 degrees Fahr., and the vacuum from 25 to 26 inches. The steam pressure varied from 153 to 156 pounds per square inch. The pressure at the steam turbine over the throttle varied from 10 to 11 atmospheres, while below the throttle it remained practically constant at 10.

The field circuit of the dynamo on positive side took 16.08 amperes, while that on the negative side took 16.29 amperes, both of which figures have been deducted in the following summation:

	Positive Side.		Negative Side.	
	Volts.	Amps.	Volts.	Amps.
Average of readings by F. W.	127.34	692.74	128.33	709.15
Average of readings by R. W.	127.17	692.22	128.20	709.21
	254.51	1384.96	256.53	1418.36
Grand average	127.25	692.48	128.26	709.18

The average watts on both sides is therefore 179,077.507, which is 90 per cent. of 198,975.01 watts or 266.72 horse-power. As the test extended over six hours, the total output was 1600.32 hp hours.

The weight of water discharged from the air pump in six hours was 27,763 pounds.

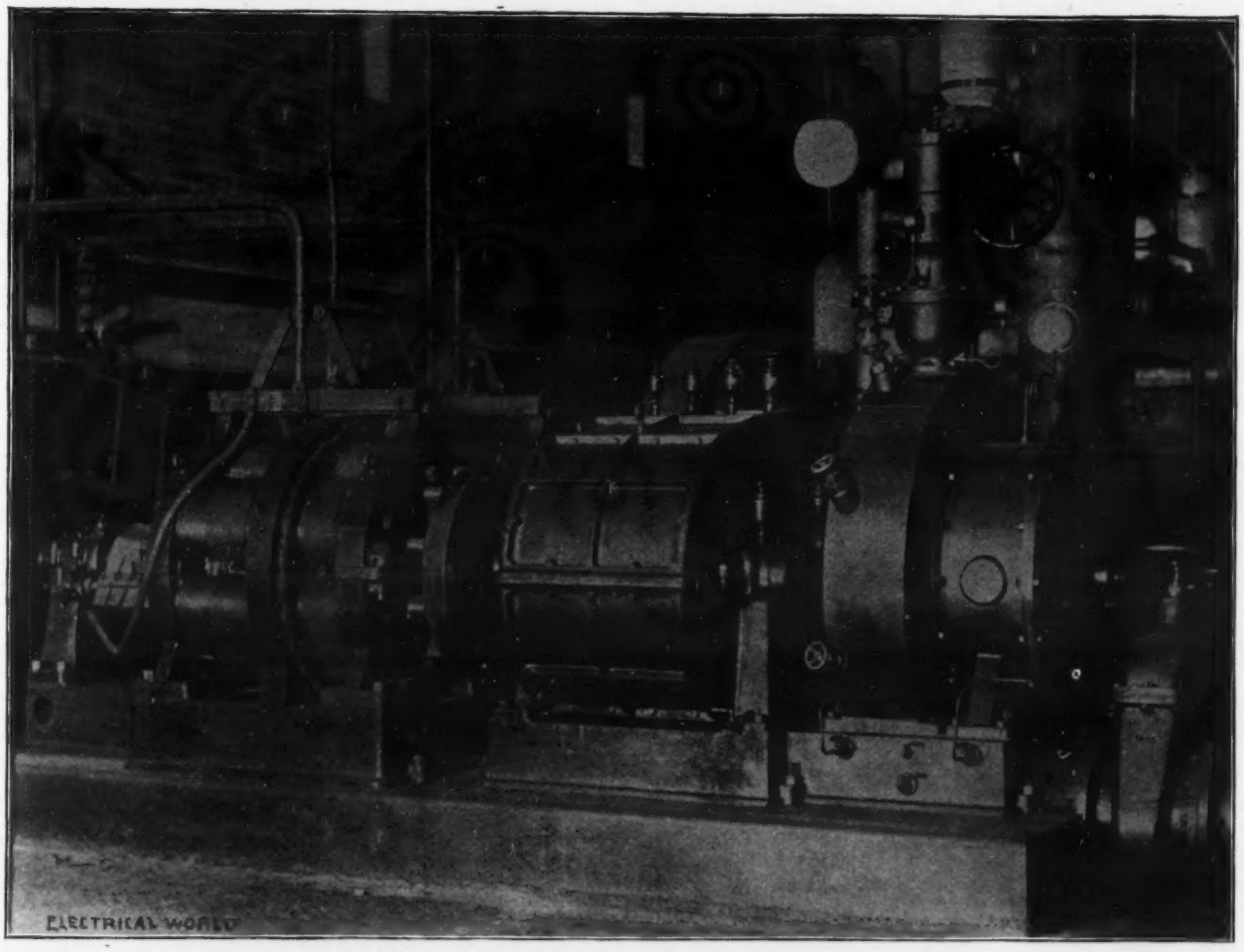
Hp-hours developed = 1600.32.

Pounds of water B. H. P. hour = 17,348 pounds.

Pounds of water per E. H. P. hour = 19.275 pounds.

The temperature readings after six hours' run with load as indicated was as follows:

	Positive Dynamo.	Negative Dynamo.
Armature	120° F.	129° F.
Average of fields	90° F.	107° F.
Commutator	144° F.	132° F.
Temperature of room	82° F.	82° F.
Temperature of armature above room	38° F.	47° F.
Temperature of fields above room	16° F.	25° F.



Laval Turbine. Direct-Connected to Desroziers Dynamos.

Test of Steam Turbine when Operated with 2, 4, 6, 7 Jets (One Hour Duration Each Test).

No. of Jets Used.	Average Load.		Average Watts.		Per Cent. of Full Load.	Vacuum.	Pounds of Steam per E.H.P.
	+ Amps.	— Amps.	+	—			
2	153.78	147.15	18.707	18.283	18.50	27.	27.35
4	433.60	455.80	54.156	57.886	56.02	26.43	20.22
6	700.85	728.65	87.746	91.268	89.51	26.07	19.75
7	771.94	787.33	97.418	100.856	99.14	25 79	19.95

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Sept. 8, 1896.

ELECTRICAL STOCKS.—In common with the general financial market General Electric stock shared in the prevailing better feeling during last week, and recorded a net advance of 3¾ points. The sales of stock during the week were larger than the average, 27,801 shares having changed hands. The highest price obtained was 28⅛, and the lowest 23½, the stock closing at 27¼.

TELEGRAPH AND TELEPHONE.—Securities of these two classes were in little demand, substantial increases in prices being recorded. The stocks showed gains in Bell Telephone, Erie Telephone, Postal Telegraph and Western Union Telegraph. In no case is a drop in price noted. Western Union ran up as high as 80½, closing at 79⅝, the net gain on the week's transactions being 2¾. The sales of this stock for the week amounted to 46,085 shares. Postal Telegraph took a jump of 5 points on the week's business. Bell Telephone closed at 205 bid, which represents a gain of 8 points over last week's closing price.

TRACTIONS.—Street railway securities felt the effect of the greater buoyancy and better feeling in the speculative world, and many gains are noted. Brooklyn Rapid Transit closed at a gain of 1¼, although the sales of the week amounted to only 630 shares. Buffalo Street Railway shows a gain of 5 points and Columbus of 5. Other gains are as follows: North Shore, common, 3; ditto, preferred, 4.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	..	..
Edison Electric Ill., New York	100	90	93
" " " Brooklyn	100	88	93
" " " Boston	100	..	..
" " " Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	23½	24⅛
Electric Storage, pref	100	25	26
General Electric	100	27½	27⅝
General Electric, pref	100	55	60
Westinghouse Consolidated, com	50	23	25
" " pref	50	48	49

BONDS.

Edison Electric Ill., New York	105	107½	108
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	85	..

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	205	206
American District Telegraph	100	*29	39
American Telegraph & Cable	100	..	89
Central & South American Telegraph	100	124	127
Commercial Cables	100	125	..
Erie Telephone	100	57½	58
New England Telephone	100	91	92
Postal Telegraph-Cable	100	77	79
Western Union Telegraph	100	79½	79¾

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	15⅜	15½
Brooklyn Rapid Transit		21	21½
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	64	66
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	43	46
Hestonville	100	45	46
" pref		..	62½
New Orleans Traction	100	7	10
" " pref	100	..	60
North Shore Traction	100	21	25
" " pref	100	72	76
Rochester St. Ry	..	15	20
Steinway Ry	..	45	50
Union Railway (Huckleberry)		98	105
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	65	..
" " pref	100	85⅛	..
Worcester Traction	100	13	15
" " pref	100	83	86

BONDS.

Brooklyn Rapid Transit 5s. 1945	100	72½	..
Buffalo St. Ry. 1st con. 5s	100	101	*104
Cleveland Elec. Ry. 1st mtge 5s	100	100	*104
*Columbus St. Ry. 1st 5s	100	90	*95
Rochester St. Ry. 1st 5s	100	95	100
Union Railway (Huckleberry) 1st mtge 5s		100	*104
*Westchester Electric 1st mtge 5s	100	100	103

* With accrued interest.

CHATTANOOGA, TENN.—J. B. Ragon has been appointed temporary receiver of the Chattanooga Electric Railway Company. Among other allegations the bill cites the bad condition of the system; the deterioration of the property in its present hands, and further charges a default in the interest of first mortgage bonds amounting to $550,000.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, September 8, 1896.

THE SPENCER ELECTRIC COMPANY reports business improving and the demand for interior work increasing.

THE NATIONAL ELECTRIC CAR-LIGHTING COMPANY has moved from 44 Broadway to the Johnson Building, 30 Broad Street, this city.

H. P. BALL MANUFACTURING COMPANY, New York, manufacturers of switchboards and electrical specialties, reports business very good, so much so that it is found necessary to double the force this week.

CHAS. J. BOGUE states that he has added a line of electrical supplies to his present repair work, and is also prepared to repair arc-lamps and furnish all parts for the same. Mr. Bogue reports that business has been very good during the season.

"ELECTRIC POWER" NO MORE—We have received a note from the office of *Electric Power* which reads: "By order of managing directors, we beg to notify you of the discontinuance of *Electric Power* magazine." *Electric Power* was a monthly and had been in existence since 1889. It deserved a better fate.

THE C. & C. ELECTRIC COMPANY has recently been awarded the contract for dynamos in the establishment of Gov. Morton at Ellerslie. These dynamos will be used for lighting, charging storage batteries and operating a pumping plant, and when this plant is completed it will probably be one of the finest private residence installations in America.

RUSSELL SAGE is quoted as saying that there has been no consolidation of Western Union and Bell Telephone stock. He stated that the Western Union Company has a large, though not controlling, interest in the Bell Telephone Company, and as to stock jobbing he said he had not bought nor sold a share of Western Union stock for some time. Mr. Sage is the second largest stockholder in the Western Union Company.

MR. JAMES D. REID, United States Consul at Dumfermline, Scotland, was a passenger on board the American liner *St. Paul* which reached New York Sept. 4. He comes to attend the annual meeting of the Old Time Telegraphers' Association at Pittsburg, Sept. 9. Mr. Reid is a patriarch of telegraphy, having been a co-worker with Prof. Morse. The United States ensign was raised and dipped from the tower at Sandy Hook in honor of Mr. Reid, and the words, "Glad to see you," were signaled as a greeting from his friends as the *St. Paul* passed in at Sandy Hook.

T. J. MURPHY & CO. report the following sales of switchboards: Knickerbocker Athletic Club, Forty-fourth Street and Madison Avenue, New York City, with 15 all-copper switches; Manhattan Hotel, with 38 copper switches; they are also finishing a board for the Museum of Natural History, which will be 15 feet long by 6 feet high and will contain 70 double-pole copper switches, with 11 Weston instruments and 10 iron-clad rheostats. By a special form of construction a comparatively small space is required. The rheostats, the handles of which only appear, are supported by the iron frame behind the board. The board is set on cast-brass pillars and encased in a cast-brass frame.

ADVERTISING IS A GOOD THING, but advertisements should be explicit. The Electric Railway Company of Rahway, N. J., advertised last week in one of the New York dailies for "experienced motormen," applicants to call at the company's office in Irving Street, without saying how many. Men came from all the surrounding cities and about 60 of them were waiting around the office at one time. As but two motormen were required, those who had come from a distance were indignant that the advertisement had not been more explicit, and the company finally considered it the part of wisdom to pay the men's fares back home. The regular employees of the company, moreover, inferred from the advertisement that they were to be discharged, and the acting Mayor called upon the company and said if out-of-town motormen were to take the place of the present men, the city authorities would take measures to bring the company to terms. It is always well to write an advertisement carefully.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Sept. 3, 1896.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, is reported to be meeting with large success as agent for the Boudreaux dynamo brush. This brush is composed of thin sheets of non-sparking anti-friction metal which takes up the current with a minimum amount of friction and wear.

DAMAGED.—On Aug. 21 a severe storm visited this place and caused much damage to property in general, including electrical plants. Trolley cars and telegraph and telephone lines in all parts of the city were more or less affected, and the barns of the Chicago City Railway Company were struck by lightning, causing a damage, it is estimated, of from $15,000 to $20,000.

THE CENTRAL ELECTRIC COMPANY, Chicago, electrical supply agent, is doing a rushing business and there is hardly any field of electrical supplies that it has not entered. It is making special efforts to advance the sales of its Röntgen-ray apparatus. It has waited until the craze has somewhat settled down and has selected equipments of outfits which are the best, and even now the company is meeting with deserved success in this branch of its business.

THE COLUMBUS CENTRAL STREET RAILWAY COMPANY went into the hands of George H. Worthington, of Cleveland, as receiver Sept 4. The company is capitalized at $1,500,000 and is bonded for that amount. It has $175,000 in notes and open accounts and $150,000 due to its president, John J. Sheperd, of Cleveland, as liabilities. The company owns a surburban road and depends largely upon this traffic for its income. The rainy season cut off this income this year and rendered the company unable to meet its obligations to small claimants. These became persistent, and the action taken is at the instance of the bondholders, who are determined to preserve the property. The directors found it impossible to borrow money.

THE FULLER FONTAINE CROSSING & ELECTRIC COMPANY, Detroit, has just completed the installation of electric plants on the New London steamers *Mohawk* and *Monhegan*, and also the Lake steamers *City of Buffalo*, *Aragon*, *Senator* and *Appomattox*. The company is now installing plants on steamers Nos. 124 and 125, of the Detroit Dry Dock line, and steamer No 88 at Capt. Davidson's Ship Building Yard, Bay City, Mich. It has also completed installing 17 motors and a 50-kw dynamo in Schilling & Co.'s plant at Detroit; also two direct-coupled dynamos at the Children's Free Hospital, Detroit. All of the company's ship plants are direct-coupled units. Several of them have been visited by representatives of THE ELECTRICAL WORLD and appear to be giving good satisfaction.

THE STROMBERG & CARLSON TELEPHONE COMPANY, Chicago, has scored a marked success at South Bend, Ind. The local system uses its instruments exclusively, and a short time ago the experiment was tried of transmitting a political speech delivered by Hon. J. L. Griffith at Indianapolis to any and all subscribers who might desire to be connected. In spite of the fact that the circumstances were unfavorable, and that Messrs. Sapp and Davis, representing the Stromberg & Carlson people, were unable to prepare anything in the line of special instruments for the transmission, the subscribers had no difficulty whatever in hearing the speech. The results were so successful that the South Bend Telephone Company will continue to give its subscribers by telephone the principal speeches of both parties during the campaign.

CANADIAN NOTES.

MONTREAL, CAN., Sept. 4, 1896.

HALIFAX, N. S.—The city electrician is preparing an estimate of the cost of remodeling the fire alarm system.

BELLEVILLE, ONT.—Messrs. Pinkerton and Cook, of Toronto, are negotiating for the purchase of the street railway franchise here.

HAMILTON, ONT.—The Radial Railway Company will extend its line from the power-house to Port Nelson, and next Spring it will be extended to Oakville.

THE C. & C. ELECTRIC COMPANY, New York, has recently been awarded the contract for two 65-kw generators for the power-house of the Temple Electric Company, Montreal, Canada.

QUEBEC, QUE.—There are now about 30 men employed on the construction of the electric street railway. The rails now being laid down in Dalhousie Street are merely temporary ones, for the purpose of leveling the track, and will be replaced by the permanent rails, which are expected to arrive in the course of a fortnight.

CHAMBLY, QUE.—The Chambly Water Power Company is coming to the front in earnest, and probably in a few weeks' time several hundred men will set at work to dam the Richelieu River at Chambly. Some time since this company gave the contract to the Stilwell-Bierce & Smith-Vaile Company, of Dayton, O., amounting to almost $1,000,000, the work to be handed over complete in the month of October, 1897. Tenders have also been invited for sub-contracts to the amount of $550,000, and they are expected to be opened within the next few days, and the fortunate tenderer started at once on this great undertaking. Mr. F. L. Beique, Q.C., of Montreal, Que., is interested in the Chambly concern as well as Mr. Holt, president of the Montreal Gas Company. The power from Chambly will have to travel about 15 miles to reach the city, but as the Niagara Falls supply Buffalo with power 25 miles away, the distance from the Richelieu to the St. Lawrence is considered no obstacle to the success of the new undertaking. It is not yet decided whether the river will be crossed by using the Victoria Bridge or by cable, but the latter plan is so much more expensive that it will not probably be entertained. Work will be begun as soon as the contracts are decided upon, and a large amount of labor will be required during the Fall and Winter months.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Aug. 26, 1896.

THE POSTAL TELEGRAPH SERVICE.—The Forty-second Annual Report of the Postmaster-General has just been published, bringing up the record of the business of the department to the year ending March 31 last. From whatever point of view we regard the telegraphic service of this country, it must be regarded as being in a most satisfactory state. At the present moment the total number of telegrams of all descriptions dealt with during the past twelvemonth, amounted to close upon 79,000 000, being an increase upon the previous year of over 10 per cent. The ordinary inland telegrams, excluding foreign, press and free messages, amounted to 64,500,000, showing an increase of 0.6 per cent. The average revenue per telegram is now 7.61d. In the year 1871-2, when the telegraphs came for the first time under the management of the Post-Office the revenue amounted to three fourths of a million. For the year 1895-6 the *total* telegraph revenue amounted to £2,879,704 and the expenditure to £2,914,581, leaving a deficit of £34,787. The contention of a large number of telegraph reformers in this country that this deficit is purely a bookkeeping one, is borne out by the fact that in this very report there is a table giving the gross and net revenue derived from the telegraph service, and showing a *surplus* of £62,000 odd. Nearly 6,000,000 telegrams were transmitted at press rates, the average weekly number of words contained in these messages being about 13,500,000. The telegrams transmitted free of charge for the railway companies amounted to no less than one and one third millions. The report states that the agreement between the National Telephone Company and the Post-Office with regard to the purchase and working by the department of that company's trunk wires was concluded on the 25th of March last, and a sum of £459,000 was paid to the company for its trunk lines, which have a wire mileage of 29,000 miles. In the telegraphic money orders business there has been an increase of 21,861 in number and of £58,573 in value. The total number of orders transmitted by telegraph in the United Kingdom during the year 1895-6 amounted to 153,318 and they had a total value of over £500,000.

A NOVEL ELECTRIC LIGHTING ENTERPRISE.—Seeing that the Shoreditch Vestry has got so far with its electric lighting scheme as to appoint a resident electrical engineer, we paid a visit of inquiry a few days ago to the station belonging to that vestry. It is expected that the concern will get to work by Christmas, but it must be confessed that if it is to do so, the rate of progress will have to be considerably quicker in the future than it has been in the past. The Shoreditch scheme contains such a unique concatenation of novel features that its progress should everywhere be watched with attention by electrical engineers. First of all the entire steam of the station will be raised by means of the hot gases from 12 refuse destructor cells, which will be fed annually by 20,000 tons of refuse, consisting largely of shavings from the cabinet making works in the district, and which in other respects will be rich in calorific material. Secondly, combined with this nearly new feature will be an entirely new item, namely, a system of thermal storage. Mr. Druitt Halpin pointed out some time ago that wherever it is proposed to make use of the hot gases from refuse destructors to raise the steam for the boilers of an electric lighting station, it would be necessary to adopt some means by which the constant rate of combustion, which results from the necessity of regularly destroying the refuse as it is brought into the station, should be turned to account, and he proposed that large quantities of hot water should be taken from the boilers and pumped into separate and well-lagged cylinders and there kept under great pressure; this hot water upon the pressure being reduced would immediately generate steam, which steam would be available for motive purposes. At first it was proposed at Shoreditch to have no less than seven steel cylinders 36 by 8 feet which should work within a range of 200 to 120 pounds per square inch. It has, however, been decided to make a tentative start with only one cylinder. Yet another somewhat novel feature of this enterprise is the fact that distribution will take place on the two-wire sub-station principle at 150 volts pressure; that is to say, half the station dynamos at the station will feed direct into the adjacent distributors and the other half will be high pressure machines which will run motor-generators situated in four sub-stations at a distance. I may say that the street arc lamps will be run 19 in series off the 1100 volt dynamos, and a novel feature connected with these will be that each arc-lamp pillar will have a couple of brackets from which will be suspended a pair of 32-cp lamps, which at midnight will be switched on from the station instead of the arc lamps, the glow lamps, of course, being run off the distributing mains. There will also be an automatic device in each arc-lamp pillar by which the glow lamps will be switched on in the event of a stoppage of any arc lamp. Further, I may say, it is proposed to light all the side streets in which there are distributors by means of two 32-cp glow lamps placed on the existing gas lamp pillars, which will be adapted to this purpose by inserting in the lantern a double curved reflector of matte zinc, after the manner just devised by Mr. Arthur Wright for the lighting of the side streets of Brighton. Another somewhat novel feature is the fact that all the mains will be lead-covered and drawn into Doulton stoneware conduits. It is also proposed to adopt Mr. Arthur Wright's demand indicator system of charging, and as regards motors it is proposed to have a special rate of 2d per unit for motors, which the owners only want to make use of between sunset and sunrise. What, with refuse destruction, thermal storage, a peculiar system of distribution, a peculiar system of street lighting, and a peculiar system of charging, the outcome of the Shoreditch scheme should contain some valuable lessons.

General News.

NEW INCORPORATIONS.

THE NEW MADRID TELEPHONE COMPANY, New Madrid, Mo., has been incorporated by F. R. Yount, J. J. Williams, Edward Delisle and others. Capital stock, $1000.

THE WESTERN ENGINEERING & CONSTRUCTION COMPANY, Des Moines, Ia., has been organized with a capital stock of $25,000, by W. E. Brice, I. W. Ong and M. H. Brice.

THE LISBON POWER COMPANY, Lisbon, N. H., has been formed with a capital of stock of $10,000. The incorporators are J. R. Atwood, C. H. Boynton and Cogswell & Oliver, Lisbon, N. H.

THE VICTOR ILLUMINATING & POWER COMPANY has been formed at Victor, Colo., with a capital stock of $100,000 Those interested are Frank H. Strong, R. G. Hillen and Moses L. Stern.

THE PENINSULA LIGHTING COMPANY, San Francisco, Cal., has been incorporated by John L. Howard, Oliver Ellsworth, Edwin Fish, Theodore F. Laint and John C. Jones. Capital, $200,000.

THE WATER, ELECTRIC & POWER COMPANY, Los Angeles, Cal., has been organized by C. E. Brooks, W. H. Shinn, W. W. Everett, G. W. Bentley and A. E. Bagley. Capital stock, $3,000,000.

THE CANTON ELECTRIC LIGHT COMPANY, Canton, Pa., capital stock $8000, has been incorporated by John A. Innes, Canton; Albert H. Perkins, Aurora, N. Y., and A. D. Williams, Canton.

CHARLESTON, S. C.—The Therrell Electric Traction Company, controlling the Therrell electric subway and electromagnetic systems for electric street railways, is now being organized in this city.

THE CENTRAL CITY ELECTRIC LIGHT & POWER COMPANY, Syracuse, N. Y., has been incorporated by Eugene Hughes, W. B. Kirk, Syracuse, and J. F. Gaynor, Fayetteville, N. Y. Capital stock $125,000.

THE UNITED TELEGRAPH & TELEPHONE COMPANY, Galveston, Tex., has been incorporated with a capital stock of $100,000. The promoters are A. Frankel, A. B. Sowden, H. H. Williams, Charles Frankel and C. and R. P. Lyon.

THE SUMMERHAYS COMPANY, Rochester, N. Y., has been incorporated for the purpose of manufacturing gas and electric fixtures. The incorporators are Marcus Hirschfield, Charles B. Griffith and Clara L. Hirschfield. The capital stock is $10,000.

THE SYRACUSE SUBWAY COMPANY, Syracuse, N. Y., has been formed for the purpose of constructing underground electric conduits. Those interested are Eugene Hughes, W. B. Kirk, A. E. Alvord and H. S. White, Syracuse, N. Y. Capital stock, $75,000.

NEW YORK, N. Y.—The State Railroad Company at Albany approved an increase of the Third Avenue Cable Company's stock from $9,000,000 to $12,000,000. The increase is to be used to extinguish the floating debt of the company, and to acquire funds for the construction of the Kingsbridge extension of the road.

KANSAS CITY, MO.—The Standard Telephone Company, which was recently incorporated with a capital of $300,000, has received its charter from the State and has already applied for a franchise. The company proposes charging $4 a month for business houses and $3 per month for telephones installed in private houses.

THE SEA BEACH RAILWAY COMPANY, a reorganization of the New York & Sea Beach Railway Company, located in Kings County, was incorporated at Albany with a capital stock of $650,000. The directors are Edward D. Lindsdale, John J. Carolan, James K. Carbiere, New York City, and Daniel W Ryan, Long Island City.

THE PACIFIC COAST GAS LIGHT & FUEL COMPANY has been incorporated at San Francisco, Cal., for the purpose of constructing electric light and gas plants. The incorporators are S. W. Van Syckel, W. C. Morris and T. W. Nowling, San Francisco; Harvey J. Lewelling, St. Helena, Cal., and Eli Lewelling, San Lorenzo. Capital stock, $500,000.

WATERBURY, CONN.—A company of capitalists have been partially organized for the purpose of building a trolley line from Torrington to Unionville, passing through Harwington Centre. The three-rail trolley system will be used. It is also proposed to have other lines from Torrington, one to Wantam Lake and another to Highland Lake, Winsted.

NEW YORK, N. Y.—A certificate of consolidation of the Manhattan Electric Light Company, Limited, and the Madison Square Light Company, of New York City, forming the Manhattan Electric Light Company, was filed on Sept. 2 with the Secretary of State at Albany. The capital stock is $1,500,000, and the directors are R. R. Bowker, E. A. Leslie, H. M. Edwards and C. S. Shepard, of Brooklyn, and Frank Enos, Englewood, N. J.

ALBANY, N. Y.—The promoters of the proposed new electric railway from Greenbush to Nassau will adopt articles of incorporation. The following committees have been appointed: Finance and Construction, John F. Late, William H. Nichols, Jesse P. Van Ness, Fred Carr and James Gray; Right of Way and Survey, Gardner Morey, Sylvanus C. Curran, Louis N. S. Miller; Subscription Committee, William H. Nichols, Bradford R. Lansing and Thomas P. James.

Telegraph and Telephone.

MORTON, ILL.—Morton is to have a new telephone line.

RILEY, WIS.—A telephone line is contemplated which will connect Dodgeville, Madison and Riley.

ROANOKE, VA.—The Roanoke Telephone Company has been granted a franchise for a telephone system.

KNOXVILLE, TENN.—The East Tennessee Telephone Company is extending its line from Clinton to Oliver Springs.

KANSAS CITY, MO.—It is announced that the telephone service between Independence and Kansas City will be doubled by increased facilities.

FRANKLIN, IND.—The City Council at a recent meeting passed an ordinance granting a franchise for a telephone system to Ferd. R. Strickler.

ORANGE, N. J.—The work of laying the subways for the New York & New Jersey Telephone Company is now in progress, and is being rapidly pushed to completion.

SAN FRANCISCO, CAL.—Owing to a cut in rates by the Western Union Telegraph Company it is considered quite probable that a reduction in telephone rates will follow.

BURLINGTON, WIS.—The Northwestern Telephone & Electric Company has accepted the franchise granted by the Council granting permission to install a telephone system.

SHELBY, ILL.—The capital stock of the Shelby County Telephone Company will be increased from $10,000 to $30,000 for the purpose of extending the line to all the towns in the county.

SOUTH BEND, IND.—The City Council of this place has ordered all telephones of the Central Union Company used by the city cut out and the connections made with the local company.

MIDDLETOWN, N. Y.—The Hudson County Telephone Company is making preparations for building a line from this city to New York. The extension to Unionville will be made as soon as possible.

MILWAUKEE, WIS.—The Wisconsin Telephone Company has just completed the metallic circuit line between this place and Green Bay. This is the second metallic circuit line in use between the two cities.

LYONS, NEB.—An ordinance was recently passed by the Town Council granting the Nebraska Telephone Company the right of way in the streets of this place. The company will extend its line to Lyons at once.

PLATTEVILLE, WIS.—The Grant County Telephone Company is negotiating for the purchase of the telephone system which connects Georgetown, Cuba City, Benton, New Diggings, Leadmine, Shullstown and Darlington.

BEVERLY, MASS.—The Postal Telegraph Company has asked for a franchise to erect poles in this place, and it is probable that the desired permission will be granted, on condition that the company establish an office here.

RUSHVILLE, IND.—The Rushville City Council has declined to permit the Central Union Telephone Company to build a toll line through this place and establish toll stations here. The Central Union will build around the town.

ST. JOSEPH, MO.—Judge Ramey recently denied the application of Daniel Ransom for a receiver for the Citizens' Telephone Company, on the ground that the action was brought for the purpose of harassing the new telephone company.

HAMMOND, IND.—The Chicago Telephone Company, which operates a line between Chicago and this city, has been granted a franchise by the City Council, giving it permission to build a main line and operate a local telephone exchange.

DETROIT, MICH.—The Michigan Bell Telephone Company has reduced its rates on business telephones from $36 to $24, and on residence telephones from $24 to $12, in order to compete with the new Citizens' Company now building an exchange here.

NASHVILLE, TENN.—The Tazewell, Sneedville & Rogersville Telephone Company is making numerous extensions. A line between Tazewell and Springdale is now being erected, and connections will be made with all the towns in the vicinity.

PITTSBURG, PA.--Bids for the construction of a complete storage battery system for the city fire alarm telegraph were opened, but the contract has not yet been awarded. The Electrical Supply & Construction Company bid $2350 and the Gamewell Company $4270.

JEFFERSONVILLE, IND.—The Home Telephone Company will present a petition at the next meeting of the Council asking for the right of way in this place. A new company is being organized by Jeffersonville, New Albany and Louisville citizens which will furnish telephones at greatly reduced rates. It is proposed to put telephones in business houses at $2 and in residences for $1 per month.

CINCINNATI, O.—Sealed proposals will be received by the Board of Fire Trustees of this city, until Sept. 10, for the manufacture, delivery and installation of underground cables for the electric circuits of the Fire Department, according to plans and specifications on file in the office of Thomas F. Clohesey, Pike Building. Bids must be accompanied by a certified check on a Cincinnati National bank for the sum of $500. D. W. Sheed, secretary.

Electric Light and Power.

MILLBURY, MASS.—The electric light plant is to be rebuilt.

CLAYTON, ILL.—Work has been begun on the electric light system in this place.

GLOVER, VT.—A movement is on foot to introduce electric lights in this place.

TABLE GROVE, ILL.—Table Grove is agitating the question of an electric light plant.

BROCKVILLE, ONT.—An electric light plant for the asylum will probably be installed.

LISTOWELL, ONT.—The Listowell Gas Company will probably put in an electric plant.

NEWBERRY, S. C.—Bonds have been voted for a new electric light and water works system.

WINCHESTER, ONT.—It is probable that the local authorities will install an electric light plant here.

VALLEJO, CAL.—A 15-year electric light franchise has been granted to K. Carper, of Nevada City, Cal.

POTOMAC, ILL.—J. K. Butz and W. J. Cosat propose to establish an electric light plant in this place.

BRANTFORD, ONT.—The Brantford Electric Light Company will put in new machinery to cost $25,000.

MANCHESTER, N. H.—Three hundred and fifty incandescent lights will be used on the semi-centennial arch.

OWEN SOUND, ONT.—The Owen Sound Electric Light Company will enlarge its plant to supply power.

NEWMARKET, ONT.—The by-law to install an electric plant has been carried. Debentures for $10,000 will be issued.

SHUBENACADIE, N. S.—A gentleman from Halifax is considering the question of installing an electric light plant here.

NEW YORK, N. Y.—An electrical plant, with a capacity of 3000 lights, is being installed in Hammerstein's Harlem Music Hall.

BOYERTOWN, PA.—A company with $20,000 capital stock is organizing for the purpose of furnishing this borough with electric lights.

MINNEAPOLIS, MINN.—The City Council has voted to grant to the St. Anthony Falls Water Power Company the right of way through the streets of the city.

LONDON, O.—The London corporation has issued $2000 additional electric light bonds for the maintenance of the new electric light plant.

CUTHBERT, GA.—An election will be held on Sept. 18, to vote on the question of issuing $7000 in bonds for the establishment of an electric light plont.

BENTON HARBOR, MICH.—The Benton Harbor & St. Joseph Electric Light Company has accepted the contract to light the city for $88 per lamp per annum.

ORANGE, N. J.—The report that the People's Light & Power Company, which lights this city, West Orange and South Orange, is to be absorbed by any other company is denied.

DETROIT, MICH.—The Board of Education will call for bids in a few days for lighting the high school by electricity. Between 2000 and 3000 lights will be required. L. H. Chamberlain, secretary, 50 Miami Avenue.

ASTORIA, L. I.—Work on the new power-house of the Electric Light & Power Company, which was begun on Jan. 1, is rapidly nearing completion, and it is thought current will be turned on in about a week.

OAKLAND, CAL.—The proposition to establish a big power plant at the Corrall Hollow mines, back of Livermore, is receiving the attention of prominent capitalists, and surveys are being made through the valleys in this county.

MILLBURN, N. J.—The Millburn Electric Company will ask for permission to erect poles and string wires through the town, for the purpose of furnishing electric light, but it is thought that the construction of a trolley road is also contemplated.

BARNUM, COL.—At a recent meeting of the Barnum Town Council an agreement was entered into with the Denver Highlands Electric Company for 11 additional arc-lights and the maintenance of the 16 now in use, for a term of 10 years, at $10 per light per year.

PITTSBURG, PA.—The contract for installing an electric light plant in the new Public Safety Building has been awarded to J. I. McShane for $3000, and the contract for a storage battery system for the fire alarm telegraph to the Gamewell Fire Alarm Company for $4270.

READING, PA.—The Metropolitan Electric Light & Power Company was obliged to shut down the Klapperthal power-house owing to low water in the Schuylkill River, and the power for the Neversink Mountain road is now being furnished by the company's plant in this city.

CHESTER, PA.—The Beacon Electric Light Company is negotiating for the control of the Chester Electric Light & Power Company's plant in this city, in order to carry out its contract to light the city before Nov. 1. If the present negotiations fall through, a plant will have to be erected.

CHICAGO, ILL.—Sealed proposals are invited by the Board of Directors of the Chicago Public Library for engines and dynamos in the Library Building, on Dearborn Park, as per drawings and specifications on file in the office of the Superintendent of the Board. W. B. Wickersham, secretary.

COLUMBUS, O.—Sealed proposals will be received at the office of the Clerk of the Board of Public Works, until 12 o'clock on Sept. 10, for lighting certain streets of the city by electricity. Separate proposals must be made upon the overhead wire system and the underground wire system.

CHICAGO, ILL.—Sealed proposals will be received at the office of the Comptroller until 12 o'clock Sept. 10, for the purpose of furnishing the City of Chicago with 1,500,000 arc-light carbons, as per specifications on file in the office of the Superintendent of City Telegraph. O. D. Wetherell, comptroller.

MIDDLETOWN, O.—The bondholders of the Edison Electric Light Company of this place have been notified by the company's managers that interest due on bonds will no longer be paid, and that owing to constant loss the plant will soon cease to be operated. A conference of the bondholders will be held within a few days, when it is probable that a receiver will be appointed for the company.

TABOR, IA.—The City Recorder received a letter from the owner of the electric light plant at Julian, Neb., in which he offers to move the plant to this town on condition that the citizens or Town Council of Tabor loan him $500, and donate a plot on which to erect a power-house. He claims that the plant is worth $3,000, but as it does not pay in Julian he wishes to move it to some other place.

MOHAWK, N. Y.—Sealed proposals will be received by the Board of Water and Light Commissioners until Sept. 10, for the furnishing and installation of electric light machinery, as per plans and specifications which may be seen by applying to C. O. Mailloux, 150 Nassau Street, New York, or of the Water and Light Commissioners, Lock Box 54, to which all proposals must sent. C. C. Steele, secretary.

THE ELECTRIC RAILWAY.

OTTAWA, ONT.—An electric railway is proposed to run between Richmond and Ottawa.

BRADFORD, PA.—Stock for the proposed electric railway from Bradford to Red Rock is being subscribed for.

EAST WINDSOR, CONN.—The trolley line from Springfield is to be extended to Warehouse Point this Fall.

WILMINGTON, DEL.—The Wilmington City Electric Company will soon begin the construction of another power-house.

NORTH TONAWANDA, N. Y.—George P. Smith has been granted permission to lay trolley tracks across the long bridge.

WILMINGTON, DEL.—Contractor Hugh E. Crilley, of Allentown, Pa., is preparing to build the New Castle-Wilmington Electric Railway.

DOYLESTOWN, PA.—The Newtown, Langhorne & Bristol Trolley Railway Company has secured the right of way between Bristol and Langhorne.

NEW BRIGHTON, PA.—There is a prospect of a speedy completion of the proposed line of the Riverview Street Railway Company in Beaver Falls, Pa.

LAKEVILLE, MASS.—The selectmen of Lakeville have granted a franchise to the Middleboro & Lakeville Street Railway Company to lay tracks in this town.

PHILADELPHIA, PA.—The applications of the Union Traction Company for permission to construct curves and crossovers in various parts of the city have been granted.

NORWALK, CONN.—Norwalk is to have a new trolley line to Roton Point. It will be built by the Norwalk Street Railway Company and will run directly through Bell Island.

HASBROUCK HEIGHTS, N. J.—A public meeting of the Council was recently held, to get opinions as to the granting of a trolley franchise to the Union Traction Company.

COLUMBIA, PA.—There is a prospect that a party of Hartford capitalists will soon secure possession of the abandoned Delaware River & Lancaster Railroad and convert it into a trolley road.

HACKENSACK, N. J.—The right of way for an electric railway through Hasbrouck Heights has been secured, and those interested now believe that the extension of the line through this place is insured

BUCYRUS, O.—The Toledo capitalists and a number of Galion parties interested in the Inter-Urban Electric Railway between this place and Galion are asking for a franchise over the public highway.

WALTHAM, MASS.—The Newton Street Railway Company will present a petition at the next meeting of the Board of Aldermen for the right of way to extend its tracks down Lexington Street to Lincoln.

CAMDEN, N. J.—The Atlantic City Railway Company has been authorized to extend the side track on the east side of its right of way across Mechanic Street to the north side of that street, west of Third Street.

BAYSIDE, L. I.—It is reported that negotiations have been concluded with the Steinway Electric Railway Company, by which its system terminating at Flushing will be extended to Bayside, a distance of about five miles.

TARRYTOWN, N. Y.—It has been reported that a cargo of ties intended for the new Elmsford and Tarrytown trolley road was wrecked in passing through Hell Gate, which will delay the completion of the line until Sept. 29.

MOUNT VERNON, N. Y.—The North Mt. Vernon Railway Company is now securing signatures of property owners to a petition for a franchise to construct a trolley road from that city along North Street and Wingate Avenue to White Plains.

BALTIMORE, MD.—It has been decided to equip the new locomotives now being built for the Baltimore & Ohio Railroad at the Baldwin Works, Philadelphia, with electric headlights. These locomotives are intended for the Royal Blue service.

KENOSHA, WIS.—The South Milwaukee, Racine & Kenosha Electric Railway Company will soon begin work. The Milwaukee Electric Railway & Light Company will build its line to a connection at that point from the present terminus in the village of Cudahy.

BRISTOL, R. I.—A petition will be presented to the Town Council by the Bristol Land & Investment Company, asking the privilege to erect a power station, lay rails, and erect poles for a local electric railway, commencing at the railway station on Thames Street.

BALTIMORE, MD.—Application was made to Mayor Hooper by the Baltimore & Ohio Railroad Company for permission to erect trolley poles on Fell and Wolfe Streets. An ordinance will be introduced in the City Council to grant the company the privilege desired.

BROCKTON, MASS.—Sixty thousand dollars are to be expended in enlarging the building and capacity of the Brockton street railway power-station. The capacity of the plant will be nearly doubled. Stone & Webster, electrical engineers, of Boston, have charge of the electrical work.

ATLANTIC CITY, N. J.—The Common Council, at a meeting held Aug. 31, passed on first reading a street railway ordinance for a double trolley track from the ocean end, through South Carolina Street, past the Pennsylvania Railroad station, up Arctic and Rhode Island Avenues to the inlet.

NEWPORT, VT.—The project is again being revived of building a railway to Newport or some other town in Orleans County, to connect with the Boston & Maine Railroad. It is proposed to operate the road by electricity, and the Legislature will probably be applied to for a charter this Fall.

ONEONTA, N. Y.—Oneonta is to have an electric railway. The old system of street railway was transferred to the Oneonta Street Railway Company. As soon as the transfer was made the new company commenced work building the new electric road. Irion Harmon is civil engineer.

PEORIA, ILL.—The Peoria City Council has granted a franchise to the Glen Oak & Prospect Heights Railway Company, and work is expected to begin in a few days. The line will run from Union Depot, through the city to the park district, and tenminate at Prospect Heights, a distance of seven miles.

DOYLESTOWN, PA.—The Bucks County Railway Company have accepted the terms of the lease drawn up by the Doylestown & Willow Grove Turnpike Company for the transfer of the road. A meeting of the stockholders will be held to ratify the lease, when work on the construction of the line will be immediately undertaken.

WORCESTER, MASS.—The directors of the Worcester & Marlboro Street Railway Company have voted to accept the terms of the decree recently offered to them by the Board of Aldermen. The company has received franchises in Westboro, Northboro, Shrewsbury and Worcester, and expects one from the City of Marlboro. Work will be commenced before November.

AUGUSTA, ME.—The Railroad Commissioners have rendered a decision on the petition of the Portland Extension Railroad Company for a location of the electric road, to extend from Westbrook to Gorham, refusing to grant the petition. The commissioners stated that there is no demand for the road petitioned for, the Portland & Rochester Railroad giving suitable accommodations.

CALDWELL, N. J.—The North Jersey Street Railway Company opened its line through Caldwell and Verona on Sept. 1. The residents of these towns

celebrated the event, many houses being decorated, and large crowds of people taking part in the ceremonies incident to the opening of the first through line between Caldwell and Newark. The fare between the two places will be 16 cents.

AUSTIN, TEX.—At a meeting of the City Council a petition was presented from Messrs. L. A. Elles, George W Littlefield, W. R. Hamby, Edwin Wilson and others, asking to be granted the right to build a street-car line along several streets. It is the intention of the promotors to begin work on the proposed line as soon as possible. The cars will be operated either by electricity or compressed air.

PORT RICHMOND, S. I., N. Y.—The Staten Island Electric Railway Company is about to construct a new interior line across the island. The line will branch off from the Richmond turnpike at Silver Lake, through the property of the New York & Staten Island Land Company, along Forest Avenue to Cherry Lane and Washington Avenue, in Northfield, to South Avenue and Richmond Terrace, having its terminus at the Elizabethport ferry. Construction on the same will be begun at once.

THE TOWN COUNCIL OF MONTCLAIR has refused to accept the proposition of the New Jersey Street Railway Company for a franchise through the town and the franchise committee has been discharged. Unless the company agrees to the terms asked for by the franchise committee, no trolley will be had in Montclair. The terms are a 5-cent fare to Newark, a 40-year franchise and the payment to the town at the end of every 10 years the sum of $200 a year for every 1000 population in the town. The company refuses to pay more than $10 a year for each car and also wants a 6-cent fare to Newark. The North Jersey County Railway Company now proposes to build a line from the Montclair line in Verona to West Orange along the mountain. For the present the company will have stages connect with the cars at the mountain top and carry the passengers to the trolley at the Glen Ridge line. The Caldwell road will be put in operation within a few days.

Legal Notes.

SEATTLE, WASH.—The Minneapolis Trust Company has brought suit against the Seattle Gas & Electric Light Company, in the Superior Court, for the sum of $10,000 due the plaintiff on a promissory note drawn Sept. 1, 1893 and made payable a year after date. The plaintiff asks judgment for this amount with interest.

NEW BRITAIN, CONN.—The Central Railway & Electric Company of New Britain has filed in the Superior Court at Hartford its answer to the recent allegations of the New England Road in the latter's suit against the three trolley companies. The New Britain Company, on behalf of the three trolley companies, denies the allegations that they entered into any illegal agreement, made any illegal transfer of stock or intend to parallel the New England Road between Plainville and Bristol.

NEWARK, N. J.—Chancellor McGill has settled an interesting point regarding the disputes of trolley and steam railway companies. The Atlantic Highlands, Red Bank & Long Branch Electric Railway Company applied to the court to have determined how it should cross the tracks of the Long Branch Railroad Company, at Red Bank. The trolley company objected to making a tunnel or building a bridge, on the ground that it would cost about $100,000. Chancellor McGill decided that the trolley may cross the railroad at grade, but the trolley company must comply with the conditions: To give a bond of $5000 to cover the reasonable expense of employees of the railroad stationed in a tower at the crossing to give signals; to erect a signal system and derailing switch by which an approaching trolley car will be automatically signaled when a train is approaching, and the trolley power at the same time cut off and the track thrown open so that if the trolley car does not stop, it will be derailed.

Personal Note.

MR. FRANK H. STEWART, the well-known electrical manufacturer and supply dealer of Philadelphia, was married on Aug. 26 to Miss Abbie Rose Kirby, of Woodstown, N. J. Mr. and Mrs. Stewart have the best wishes of their many friends for a long and happy wedded life.

Trade and Industrial Notes.

DE VEAU & CO., New York, manufacturers of telephones, have just secured the contract for the equipment of the Siegel, Cooper building with telephones.

ASSIGNED.—Messrs. MacCurdy & Smith, electrical supply dealers, Indianapolis, Ind., made an assignment on Aug. 29 to Charles S. Tarlton. The liabilities and assets it is said are small.

THE ARMOUR INSTITUTE OF TECHNOLOGY, Chicago, has issued its year book for 1895–96, setting forth the several courses which it offers for students, among which are included mechanical, electrical and chemical engineering.

PITTSBURG, PA.—It is reported that the largest dynamo ever constructed is now being built at the works of the Westinghouse Company, East Pittsburg. It is intended for the Allegheny County Light Company, and when completed will weigh 90 tons.

THE RHODE ISLAND BRAIDING MACHINE COMPANY, Providence, R. I., has just issued an illustrated catalogue and price list of its wire covering braiding machines. This company manufactures machines for making braids of all varieties, including those for covering heavy and light electric wires.

SYRACUSE, N. Y.—The office of the Electrical Supply Company, Syracuse, N. Y., was closed on Aug. 29 by order of Deputy Sheriff Whittic, upon executions issued under two judgments. One was in favor of Clara E. Hamilton for $8316.98, and the other in favor of the New York Insulated Wire Company, for $498.40.

THE JEFFREY MANUFACTURING COMPANY, Columbus, O., in its catalogue No. 46, describes and illustrates the Robinson Coal Washing Machinery. Small coal when washed burns more freely, gives more heat and burns up more completely. A great deal of matter of interest to steam users will be found in this catalogue.

THE WESTINGHOUSE MACHINE COMPANY, Pittsburg, has issued a catalogue descriptive of its standard, compound and junior engines together with notes on their construction, regulation, testing and economy. The pamphlet also contains a number of half-tone photographs of representative plants in which Westinghouse engines have done good service.

MR. GEORGE PELLINGER, manager of the electrical department of the Goodyear Vulcanite Company, New York, manufacturer of hard rubber for mechanical purposes, reports having recently received some nice orders for hard rubber from good representative electrical concerns. Business is gradually improving and the prospects for Fall trade are encouraging.

THE GENERAL ELECTRIC COMPANY has now ready for distribution a small brochure on the long-burning arc-lamps manufactured by it. The pamphlet contains illustrations of the different lamps of this character made by the company, with the cost of maintenance, etc. A copy may be obtained by addressing any of the offices of the General Electric Company.

THE BALL ENGINE COMPANY, Erie, Pa., reports an encouraging increase in orders during the past few weeks for electric light engines. Among the reported shipments during the past month may be mentioned one 200-hp cross-compound engine for the Bradford Electric Railway Company, Bradford, Pa.; two 175-hp engines, one each for the National Galvanizing Works, McKeesport, Pa., and one for the National Tube Works, of the same place. Other shipments include five 100-hp engines and several smaller types.

THE GOUBERT MANUFACTURING COMPANY, New York, has just issued an artistic and interesting catalogue of its well-known Goubert feedwater heater and Stratton separator. The class of work done by this firm will be of interest to all users of steam power. Some idea of its magnitude can be gathered from the catalogue tables of dimensions in which are given the data on heaters from 50 up to 6000 horse-power. A perusal of a long and satisfactory list of customers given in the last pages discloses the interesting fact that the majority of the largest heaters sold are in use by electric light or railway plants.

THE HOPPES MANUFACTURING COMPANY, Springfield, O., manufacturer of the well-known Hoppes purifiers and heaters, has been fairly busy during the past 60 days, having sold over 9000 horse-power of its productions. Among some of the recent sales we note the following: Springfield, O., Light & Power Company, 85-hp purifier; Gibonsburg, O., Electric Light Company, 100-hp heater; the Suburban Gas & Electric Company, Revere, Mass., 500-hp heater; Preston, Minn., Electric Light & Water Works, 100-hp heater. The company has also sent out a 1200-hp heater, together with several smaller sizes and several large-sized purifiers.

ELECTRIC LOCOMOTIVES.—The Baldwin Locomotive Works, Philadelphia, and the Westinghouse Electric & Manufacturing Company, Pittsburg, have jointly issued a very handsome catalogue on the subject of electric locomotives, a varied line of which these companies are now manufacturing. The different classes of these machines include express locomotives, freight locomotives, switching locomotives, suburban and elevated railway locomotives, mine locomotives, rack locomotives, etc. The locomotives of the various classes are illustrated in perspective and diagrammatically, and the trucks and electrical apparatus are also fully and artistically illustrated. Some diagrams are given illustrating the elementary principles of the electric motor and some characteristic curves of motors are also presented. This is the first catalogue of its kind, and it is very handsomely gotten up.

THE EDWARD P. ALLIS COMPANY, Milwaukee, Wis., has just issued a little pamphlet devoted entirely to a list of electric and cable railways using its machinery, including some of the most notable railways in the United States. The company has an enormous factory, a good idea of the magnitude of which may be obtained from the following facts: The frontage on Clinton Street is 1400 feet, the total area of the grounds is 24 acres, and there are 18 acres of actual floor space in the buildings. The works cover five blocks, and the number of men employed is 1600. In descriptions of electric lighting and power plants which have appeared from time to time in our columns, the E. P. Allis Company's engine has frequently figured. Of late readers of these articles will have noticed that a new valve-gear, with an arrangement for connecting the reach-rod with the wrist-plate, is finding favor.

EUGENE MUNSELL & CO., New York, state that their mica business has been established more than 50 years, and when there began to be a call for mica for electrical insulation, their experience enabled them to meet the demand. They have since been constantly enlarging their facilities, and studying to meet the varying and increasing requirements of the electrical trade. They also state that their mica is received direct from the mines, and not through second hands. Mr. Frankin Brooks, the junior member of the firm, has recently spent considerable time among the rich mines in Bengal, India, perfecting arrangements by which they received the finest electrical mica in the world selected and prepared according to their own instructions. They also have extensive relations with Canadian miners which enables them to furnish the best amber mica where that quality is desired. Eugene Munsell & Co. guarantee almost immediate delivery of any orders placed with them. The company has recently established a branch house at Chicago to supply their Western customers.

Business Notices.

The illustrations in this issue were made by the Photo-Engraving Company, 67–71 Park Place, New York.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren Street, Syracuse, N. Y.

HARVEST EXCURSIONS.—In order to give every one an opportunity to see the grand crops in the Western States and enable the intending settler to secure a home, the Chicago, Milwaukee & St. Paul Railway has arranged to run a series of harvest excursions to South and North Dakota, and to other States in the West, Northwest and Southwest on the following dates: July 21, Aug. 4 and 18, Sept. 1, 15, 29 and Oct. 6 and 20, at the low rate of $2 more than ONE FARE for the round trip. Tickets will be good for return on any Tuesday or Friday within 21 days from date of sale. For rates, time of trains and further details apply to any coupon ticket agent in the East or South, or address E. F. Richardson, General Agent Pass. Dept., 381 Broadway, New York. (9-19)

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPT. 1, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

566,760. ELECTRIC SWITCH; J. L. Hornig, St. Louis, Mo. App. filed Feb. 26, 1896. In an improved switch, a suitable block, a disc mounted for rotation within said block, a spring-actuated handle for rotating said disc, means for holding said handle in a set position, conductor plates arranged in said disc at right angles to each other, brush-holders arranged above said block, suitable tension devices for said brush-holders, brushes passing vertically through said brush-holders, the lower ends thereof engaging upon the periphery of the disc and adapted to contact with the ends of the conductor plates, suitable connections from two of said brush-holders to a single conductor, and suitable connections leading from the remaining brush-holders.

566,762. VILLAGE OR HOUSE TELEPHONE SYSTEM; E. G. Hovey, Chicago, Ill. App. filed May 4, 1895. In a village or house telephone system, the combination with a number of telephone lines extending to each of a number of sub-stations, each telephone line being provided at ach sub-station with a switch socket, of a plug connected with the telephone set at each sub-station and adapted to be inserted into the switch socket of any telephone line to connect the telephone set in circuit therewith, a local signal or alarm circuit at each sub-station, said local circuit including a battery, a signal device, the switch contacts operated by the telephone hook, and a pair of contacts provided in connection with the individual switch socket, that is, the switch socket in which the plug is adapted to normally rest, said contacts being separated when the plug is inserted, and closed together when the plug is removed, the circuit being thus open at two points during conversation, that is, at the contacts controlled by the telephone hook and at the contacts controlled by the insertion of the plug; whereby when the plug is not in the individual socket the contacts upon the switch-socket are closed, and the local circuit is completed through the contacts controlled by the telephone hook when the telephone is hung up, while if the plug be returned to the individual socket, the local circuit is not completed when the telephone is hung up.

566,784. SELECTIVE SYSTEM; A. L. Merrick and B. Brooks, Springfield, Mass. App. filed Sept. 16, 1892. The combination in an individual selective system, of a polarized apparatus, an armature movable in two directions, a contact pin or plate adapted to be carried by the armature moving in one direction to the requisite position for connection, a circuit adapted to be closed by the contact pin when the armature is moved in the opposite direction, a retaining pawl disengaged simultaneously with the closing of the circuit, and means operating independently of the current to return said contact pin or plate to its normal position when rendered free to return by discontinuance of the current.

566,786. ELECTRIC RAILWAY SYSTEM; J. M. Murphy and A. F. Pierce, Danbury, Conn. App. filed Sept. 10, 1895. In a sectional conductor electric-railway system comprising a main circuit or conductor, a series of rail conductors, laterals connecting such rail conductors and the main conductor, switch devices each connecting a pair of laterals having a step-by-step movement and adapted at each operation to alternately cut out one lateral and close the circuit in the other, a pivoted lever arm extending under the track, having at one end a pawl mechanism arranged to operate the switch devices of each pair of laterals, and having at the other end a tread or presser member extending up adjacent to the track to be engaged by the passing car wheels.

566,795. ELECTRIC HEATER; F. L. Pruyn, Albany, N. Y. App. filed Aug. 1, 1895. In an electric heater, the combination with an insulating support of pins provided thereon and arranged in two longitudinal rows, the pins of the two rows alternating in longitudinal position—that is, a pin of one row occupying a position between the positions of two pins of the other row—and a coiled conductor passing around a pin of said rows, then encircling the insulating support and passing around a pin of the other row, the coiled conductor being thus passed back and forth around the support and looped about the pins of the two rows alternately, the pins of the two rows being disposed so that the loops will not overlap in a transverse direction while overlapping in a longitudinal direction, whereby a greater number of convolutions may be placed upon the support than if the pins were arranged in a single longitudinal row, since the loops overlap longitudinally instead of transversely, and in consequence the convolutions may be brought closer together.

566,801. ELECTRIC RAILWAY SYSTEM; W. Robinson, Boston, Mass. App. filed Dec. 19, 1894. In an electric railway system, the combination of a feed wire, a working conductor made in successive sections normally disconnected from said feed wire, a motor traveling in electric connection with said working conductor, a circuit continuously closed and an independent electromagnet included therein, said magnet being operated or controlled without actually opening the circuit thereof, the actuation of said magnet opening to connect one of said sections of working conductor to the feed wire, and to disconnect the same therefrom.

566,829. TOLL-BOARD APPARATUS FOR TELEPHONE EXCHANGES; V. Wietlisbach, Bern, Switzerland. App. filed Feb. 1, 1895. The combination with an induction and repeating coil, of a movable armature for the core thereof, a local circuit, including an electromagnet actuating a signal device, adapted to display its signal only when said magnet is not excited, contact points controlled by said armature adapted to close said local circuit when said armature is in its attracted position, also when the armature is in its position of rest but to open the circuit while the armature is moving from either one position to the other.

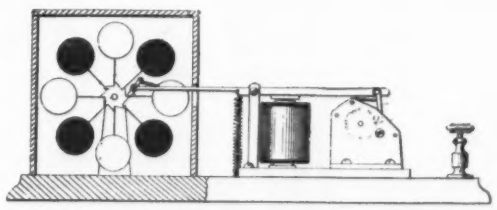
566,843. TOWER-STRIKER; F. W. Cole, Newton, Mass. App. filed July 24, 1894. In a tower-striker, the combination of motor-driven ratchet-wheel, a rocking cradle and pawls connected therewith and operated by said ratchet-wheel, a hammer and connections between it and the cradle, electromagnetic let-off mechanism, and restoring mechanism therefor, a counter-balancing spring connected at its lower end with the frame, a nut having a reduced neck embraced by the end coil, at the upper end of said spring, and a link.

566,860. ELECTRICAL CONSTRUCTION, REGULATION AND DISTRIBUTION; T. H. Hicks, Detroit, Mich. App. filed Feb. 1, 1895. In a system of electrical regulation, the combination of two electric generators and a work circuit, one of said generators being arranged to act as a counter E. M. F. against the second generator, said generator which acts as a counter force being provided with a series-differential coil.

566,874. ELECTRICAL DISTRIBUTION MACHINE; W. E. Sinclair, Milwaukee, Wis. App. filed July 25, 1895. An electric distribution machine, comprising a series of automatic quick-break knife-switches, each of which is for incorporation as part of an electric circuit, a power shaft, a counter shaft in gear with the power shaft, and a series of rotarily-adjustable switch-closing cams carried by the counter-shaft.

566,887. DETECTOR FOR RAILWAY SWITCHES; W. H. Berrigan, Jr., Brooklyn, N. Y. App. filed April 26, 1895. A track circuit for railway purposes, including the main rails from a point considerably distant from the points of the switch in one direction to a point considerably distant beyond the frog in the other direction, and including also siding-rails from the points of the switch to a point considerably distant beyond the frog portions of the main and siding-rails being insulated, in combination with an electromagnet included in said circuit, for controlling switching mechanism.

566,889. ELECTRIC MOTOR; J. Bram, Decatur, Ill. App. filed Sept. 5, 1895. In an electric motor, the combination with the field magnet cores having pole-pieces and air passages which extend through said cores and pole-pieces, of an open armature comprising a central shaft, an open-arm spider rigidly secured upon each end portion of the said shaft and having a continuous ring or rim of a diameter considerably larger than that of the shaft, a series of radial core posts carried by the said rims or rings, slotted and flanged longitudinal bobbins wound with coils and seated upon the said posts, and convexo-concave magnetic plates which connect opposite pairs of the said posts.



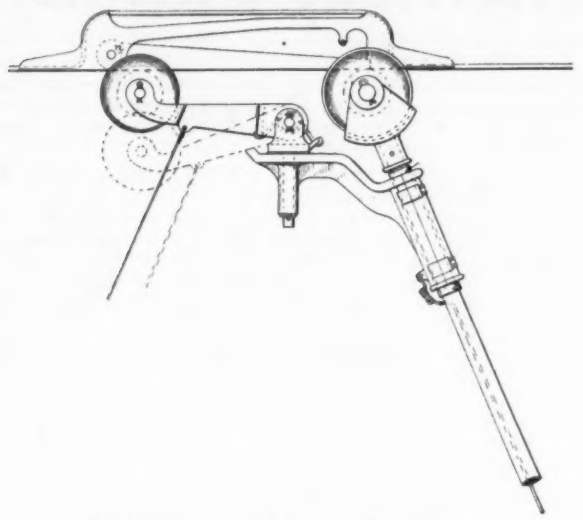
No. 566,951.—SIGNALING DEVICE.

566,892. REGULATING SOCKET FOR ELECTRIC LAMPS; C. A. Chute, Chicago, Ill. App. filed Feb. 8, 1896. A regulating socket for electric lamps having in combination with an insulating spool, a wire capable of resisting the passage of electricity, and adapted to be wound helically upon said spool, metallic guide rods attached to said spool, a metallic terminal or pole plate, means for connecting one of said rods, a metallic slide constructed to engage said guide rods and to be moved up and down thereupon, a spring-operated contact pin in metallic connection with the slide, and mechanism for operating the slide.

566,894. APPARATUS FOR EXTRACTING GOLD AND SILVER FROM ORE; P. Danckwardt, New York, N. Y. App. filed June 8, 1896. The combination of a revolving barrel having an amalgamated copper lining to form a negative pole, with a pair of heads, and with a series of insulated inclined blades secured to such heads and having overlapping edges to form the positive pole.

566,896. ELECTRICAL SELECTING INSTRUMENT; A. Duppler, Jersey City, N. J. App. filed Feb. 12, 1895. In a selecting instrument, a movable phase-completing device adapted to respond to a fixed combination of electrical impulses from a transmitter, and provided with notches, in combination with an electromagnet and its armature lever, and provided with an actuating pawl arranged to co-act with the notches in the phase-completing device, means actuated by a false impulse to throw the pawl out of the notches, and means for retaining the phase-completing device when the pawl is thrown out.

566,914. ELECTRIC SELECTOR; A. le Blanc, New York, N. Y. App. filed Oct. 3, 1893. In an electric selecting instrument, a magnet provided with an armature responding to impulses of opposite polarities, in combination with devices actuated mechanically by the armature in responding to impulses of one polarity, whereby the selecting instrument is brought to the end of its phase, and devices actuated by the armature in responding to an impulse or impulses of opposite polarity to those above referred to, whereby all other selecting instruments within the circuit are restored to starting point without affecting the one selected for operation.



No. 566,984.—Electric Railway.

566,915. ELECTRIC SELECTOR; A. le Blanc, New York, N. Y. App. filed Nov. 11, 1893. In an electric selecting instrument and electromagnet provided with an armature-lever and means for transmitting electrical impulses of opposite polarity through the coils of the magnet in combination with devices responding to the impulses of one polarity to thereby impel the selecting instrument to the end of its phase, and devices actuated by impulses of opposite polarity to thereby restore all other instruments on the line to starting point, both operated by the movement of the armature-lever in the same direction.

566,916. SELECTING DEVICE; A. le Blanc, New York, N. Y. App. filed Jan. 16, 1894. In an electric selecting instrument adapted to respond to impulses from a local battery to work out its phase, the combination with two electromagnets in the local circuit and an armature lever common to both magnets, of a transmitting instrument adapted to transmit impulses of opposite polarities to thereby direct the current of the local battery to either magnet according to the polarity of the impulse transmitted, and means operated mechanically by the armature-lever in response to the attraction of one of the magnets to thereby actuate the selecting instrument to the end of its phase and means actuated by the same armature in responding to the attraction of the other magnet to hereby restore the selecting instrument to starting point.

566,917. ELECTRICAL TRANSMITTING INSTRUMENT; A. le Blanc, New York, N. Y. App. filed Oct. 16, 1894. In an electrical transmitting instrument, a disc-carrying shaft provided with means for imparting a rotary movement thereto, in combination with a disc secured in a fixed position on said shaft and provided with a series of teeth arranged in succession to co-operate with a suitable conductor, and thereby transmit electrical impulses of one polarity, and a series of discs each provided with a set of teeth differentially composed or arranged to co-operate with a conductor, and thereby transmit electrical impulses of an opposite polarity to those transmitted by the fixed disc, said series of discs adapted to be adjustably arranged on said shaft, whereby each of them may be combined with the teeth on the fixed disc to co-operate therewith and co-operate different combinations of electrical impulses of opposite polarities.

566,918. ELECTROMAGNET; A. le Blanc, New York, N. Y. App. filed Oct. 16, 1894. In an electromagnet, an outer casing, a core enclosed within said casing, both of magnetizable material, two coils wound between them, one at each end and separated from each other, thereby forming a double magnet, one at each end, in combination with a movable plate armature at each end of said core and casing, and constructed to register with and cover both core and casing.

566,936. AUTOMATIC STARTER FOR ELECTRIC MOTORS; J. E. Putnam, Rochester, N. Y. App. filed Feb. 29, 1896. The combination with the electric motor of a variable resistance and contacts, an operating lever and a contact lever provided with a lug, springs on the lever, and suitable means driven by the motor for operating the first said lever according to the speed of the motor.

566,939. ELECTRIC CAR BRAKE; Alex. B. Roney, Chicago, Ill. App. filed April 2, 1895. In an electric car-brake, the combination with a motor, a screw-threaded shaft driven thereby, and a yielding connection between said shaft and the armature of the motor, of a nut working on said shaft and held against rotation, and a brake-rod connected with, and actuated by said nut substantially as described.

566,951. SIGNALING DEVICE; H. L. Webb, New York, N. Y. App. filed March 18, 1893. The combination with an electrical-impulse-transmitting instrument and a selecting instrument adapted to respond to electric impulses from said transmitter, of a signaling device in connection therewith adapted to be moved step by step and thereby display successive signals alternating in sign at each step, an electromagnet responding to the impulses and provided with an armature-lever and its retractile spring, means for actuating the selector operated by said lever when approaching the pole of its magnet and means for actuating the signal device operated by said lever when retracted by its spring.

566,984. ELECTRIC RAILWAY; R. M. Hunter, Philadelphia, Pa. App. filed Feb. 3, 1896. A railway, a suspended conductor arranged along said railway, an electrically propelled car, and a frame having one end connected to the car and the other end guided by the suspended conductor, in combination with an independent trolley or current-collecting device universally hinged or jointed to and carried by said frame close to the suspended conductor and making a spring-actuated contact with said conductor, and an electric circuit leading from said trolley device.

566,985. TELEGRAPHY; J. M. Joy, New York, N. Y. App. filed June 17, 1895. In a single line battery system, for printing or analogous apparatus, the combination of a closed electric circuit including several stations, a source of current in the circuit at one of the stations, an alternator at the same station for alternating the current from the source, and transmitting apparatus at the stations adapted to govern the action of the pole-changer to determine the number of its impulses.

567,023. AUTOMATIC CIRCUIT-CONTROLLER FOR ELECTRIC PUMPS; D. W. Dunn, Wrentham, Mass. App. filed May 1, 1895. In combination, an electric motor, a pump driven by it, a reservoir supplied by the pump, a piston exposed to the pressure of the air in the reservoir and a switch whose moving member is moved up to a dead point by the piston and beyond that dead point by power stored up during its motion up to the dead point.

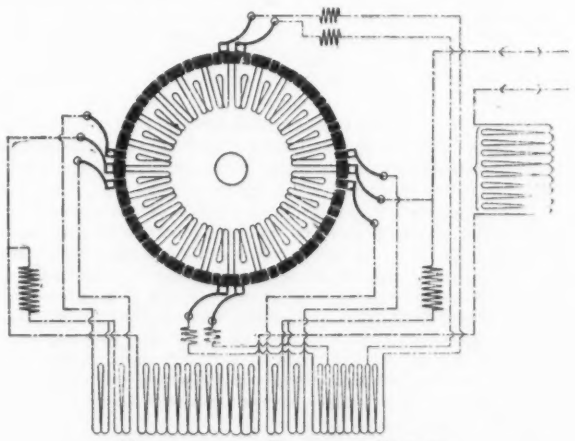
567,044. PLATE FOR SECONDARY VOLTAIC BATTERIES; J. G. A. Rhodin, Clifton Hall, England. App. filed Oct. 7, 1895. A plate for secondary batteries consisting of a perforated frame plate in combination with plugs composed of a bundle of lead wires filling the perforations of said frame-plate and producing preamble plugs to the interstices of which the electrolyte has access.

567,045. PLATE FOR SECONDARY VOLTAIC BATTERIES; J. G. A. Rhodin, Clifton Hall, England. App. filed Sept. 25, 1895. A plate for secondary batteries, consisting of a perforated frame plate, in combination with plugs composed of a roll of lead provided with projecting solid ribs joined by a thin film of lead, said plugs filling the perforations of said frame plate and producing permeable plugs to the interstices of which the electrolyte has access.

567,077. TELEPHONE TRANSMITTER; N. L. Burchell, Washington, D. C. App. filed Sept. 5, 1895. A telephone transmitter having electrodes which are relatively fixed and immovable, a primary diaphragm, a secondary diaphragm on which said electrodes are rigidly mounted with an interval of separation, a connection between the primary and secondary diaphragm whereby both shall vibrate in unison, and a granular conducting material for a variable resistance medium enclosed in a chamber which also contains the electrodes and means for varying the space enclosed by said chamber.

567,112. ELECTKICAL COMMUNICATION; J. A. Sullivan, Cincinnati, O. App. filed July 15, 1893. The combination in an electrical instrument in a circuit of a permutation-wheel, having an armature mounted thereof and attached thereto, the wheel being in such relation to a magnet that the attraction of the magnet causes the rotation of the wheel, a magnet and a battery.

567,118. TROLLEY; F. W. Canales, Portland, Me. App. filed Jan. 22, 1896. In a trolley in combination, a base, a plate pivotally attached thereto and having uprights made integral therewith, a yoke pivotally attached to said uprights, a wheel pivotally mounted in said yoke, means for holding the wheel and yoke erect, and means for conducting the electricity from the wheel to the trolley pole.



No. 567,119.—Electric Motor.

567,119. ELECTRIC MOTOR; R. Eickemeyer, Yonkers, N. Y. App. filed Dec. 31, 1890. In an electric motor adapted to be operated by alternating currents, the combination of a field coil, an armature having coils connected in series in the alternating-current circuit, and a counter-field coil closely surrounding said armature and also in series with the field coils, and with the armature coils, but organized to permit the current to flow in said counter field in a direction opposite to the current in the armature-circuit, whereby the coils of the armature, and the said counter field, will afford a non-inductive circuit and operate as a means for counterbalancing the E. M. Fs of self-induction in the several armature coils by the alternations of the magnetic field of the armature current.